
**MINI-HYDRO/WATER SUPPLY
FEASIBILITY STUDY
FOR RIGOLET, LABRADOR**

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FOR RIGOLET, LABRADOR**

**Prepared for:
The Community of Rigolet**

**Prepared by:
Sheppard, Hedges and Green Limited**

**With contributions from:
Newfoundland and Labrador Department of Municipal Affairs,
Newfoundland and Labrador Hydro,
and
Remote Community Demonstration Program
of Energy, Mines and Resources Canada**

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RCDP/PDCE-50

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ABSTRACT:

This study was carried out for the Community of Rigolet, Labrador and funded under the Remote Community Demonstration Program of Energy Mines and Resources Canada with contributions from the Department of Municipal Affairs of the Province of Newfoundland and Labrador and Newfoundland and Labrador Hydro.

The study investigates the economics and technical feasibility of combining a water supply and a mini hydro project in the remote coastal Labrador Community of Rigolet.

The hydro power generated would reduce that required to be produced by the four (4) existing diesel power generation units with resultant fuel cost savings.

The proposed scheme combines pumping, siphon action and gravity flow to two (2) impeller turbines. Water is fed to the turbines through a 610 mm diameter 2480 metre long penstock by a propeller pump located in a vertical intake pipe. The penstock is a siphon and the pump is used to add head at the intake thereby reducing the siphon head and consequently the negative pressures at the high point of the siphon.

The turbines will operate under steady state conditions with load changes accommodated by an electronic load governor rather than gates, enabling the flow to the turbines to remain constant and thereby eliminating hydraulic transients in the penstock.

The system has been sized to meet as closely as possible the demand during the months from May to November, and the available flow from inflow and storage during the months from December to April consistent with the most economical penstock size and dam height.

Water is supplied to the Community through the existing distribution piping system tapped to the penstock above the turbines.

The capital cost of the joint project is estimated at \$2,630,000.00 in 1986 dollars. The project can be completed in approximately eight working months but because of severe winter conditions and equipment delivery times the actual time required to complete the project will be sixteen (16) months.

The results show that the joint project is cost-effective with cross-over occurring in nineteen (19) years.

The project is technically feasible and demonstrates several unique features in hydro system design.

ÉTUDE DE FAISABILITÉ D'UNE MINI-CENTRALE HYDROÉLECTRIQUE

RIGOLET, LABRADOR

Résumé

L'étude considère la possibilité économique et technique de combiner un système d'approvisionnement en eau et une mini-centrale hydroélectrique dans la localité éloignée de Rigolet, sur la côte du Labrador.

L'électricité ainsi produite remplacerait une partie de l'énergie fournie par les quatre centrales au diesel déjà en place et se traduirait donc par des économies d'argent.

Le plan proposé combine le pompage, l'action d'un siphon et l'écoulement par gravité. L'eau est amenée à deux turbines-hélices dans une conduite forcée de 610 mm de diamètre, de 2 480 mètres de longueur par une pompe à hélice installée dans une prise d'eau verticale. La conduite forcée est un siphon et la pompe permet d'augmenter la hauteur de la prise d'eau, réduisant ainsi la hauteur du siphon et, par conséquent, les pressions négatives au sommet du siphon.

Les turbines fonctionneront en régime permanent; les variations de la charge seront commandées par un régulateur de charge électronique plutôt que par des vannes, ce qui permettra de maintenir un débit constant aux turbines et d'éviter les régimes transitoires hydrauliques dans la conduite forcée.

La puissance de la centrale a été calculée en fonction de la demande de mai à décembre et du débit disponible à l'admission et au réservoir entre décembre et avril, tout en maintenant les dimensions de la conduite forcée et la hauteur du barrage aux niveaux les plus économiques possibles.

La collectivité sera alimentée en eau par le réseau de distribution en place que l'on reliera à la conduite forcée, au-dessus des turbines.

Le coût d'investissement de ce projet mixte est estimé à 2 630 000 \$, en dollars de 1986. Les travaux peuvent s'effectuer en environ huit mois mais, à cause de la rigueur de l'hiver et les délais de livraison d'équipement dans cette région du pays, il faudra en réalité 16 mois pour mener le projet à terme.

Les résultats de l'étude de faisabilité montrent que le projet mixte est rentable et que la période de recouvrement de l'investissement serait de 19 ans.

Le plan est techniquement réalisable et comporte plusieurs caractéristiques uniques dans le domaine de l'hydroélectricité.

Cette étude a été effectuée pour la localité de Rigolet par la société Sheppard, Hedges & Green Limited de Gander et Clarendville, Terre-Neuve, avec la participation du Programme de démonstration dans les collectivités éloignées d'Énergie, Mines et Ressources Canada, du ministère des Affaires municipales de Terre-Neuve et du Labrador et de la Newfoundland and Labrador Hydro.

1.0 INTRODUCTION:

In June 1983, Sheppard, Hedges and Green Limited submitted a proposal to Energy Mines and Resources Canada on behalf of the Community of Rigolet to study the feasibility of combining a water supply system with a mini hydro electric power generation system. The study was to be carried out jointly by Sheppard, Hedges and Green Limited and Acres Consulting Services Limited with Sheppard, Hedges and Green Limited providing the study management, economic analysis, preliminary investigations, civil engineering related to the water supply and the hydro schemes, and Acres Consulting Services Limited providing the hydrology, power and energy studies and the technical expertise for alternative system analysis and selection.

The study proposal was approved in a modified form in November 1983 with funding being provided by the Department of Municipal Affairs, Government of Newfoundland, Newfoundland and Labrador Hydro, and Energy Mines and Resources Canada. The Newfoundland and Labrador Hydro contribution was in the form of manpower to undertake the hydrology and power and energy portions of the study while the remaining cost was shared on an equal basis between the Department of Municipal Affairs and Energy Mines and Resources Canada.

While Newfoundland and Labrador Hydro completed much of the work originally proposed to be carried out by Acres, because of the significant technical problems encountered in the various schemes considered, it was necessary to make significant use of Acres' expertise in hydraulics, system selection, analysis and optimization of the schemes.

Because of the late approval and resulting inclement weather conditions, survey work and initial investigations could not be completed in the fall of 1983. Most of the work on the feasibility study could not proceed until after this remaining survey work and site investigations were completed in June 1984 when weather conditions were suitable.

Three alternatives were identified in the original proposal, all of which were investigated before determining that the scheme identified here was the most technically and economically feasible solution combining a water supply with a mini hydro project.

The study was carried out in five stages as identified in the Agreement between the Town and Energy Mines and Resources Canada, a portion of which is shown below:

Stage 1 - On-Site Work

The initial investigation will include a site visit to determine the on-site work requirements. A suitable scale map will be produced from aerial photographs. Site reconnaissance and survey work will be done to gather the site-specific information necessary to produce sketches and cost estimates. The natural flow regimes will be estimated from regional hydrology data which will be collected if not available.

Stage 2 - Conceptual Development

The conceptual development will include the examination of the various possible routes for the water main from the reservoir. The possible routes will be evaluated and the best option selected. The most appropriate size for the dam (to create the reservoir) and for the water main will be determined. This size will be sufficient to allow the water main to serve as a penstock for the proposed hydro project. An assessment of the possible environmental effects will be done.

Stage 3 - Hydrology Power and Energy Study

Newfoundland and Labrador Hydro will carry out the necessary hydrology work using regional hydrology information developed by Newfoundland and Labrador Hydro and additional hydrology investigations as required. Also, Newfoundland and Labrador Hydro will conduct a power and energy study for each alternative identified.

Stage 4 - Preliminary Engineering Design/Technical and Economic Feasibility

The technical feasibility of the project will be determined. Preliminary engineering designs will be prepared and from these cost estimates will be developed. The economic feasibility of the project will then be determined which will include an energy demand study. The possible impact of conservation will be taken into account when forecasting demand. The load pattern will be determined and taken into consideration in determining the optimum size of the hydro plant. The economic feasibility of the most viable option will be compared to the cost of the existing diesel generated electricity.

Stage 5 - Report

A draft of the final report will be prepared. This draft will be reviewed by the steering committee and both parties to the agreement. These comments will be taken into consideration in the preparation of the final report. A final report will be prepared, which will include as a minimum:

- i) table of contents
- ii) summary or abstract
- iii) introduction
- iv) technical discussions
- v) findings and conclusions
- vi) bibliography and/or references

The completed report will be submitted in one reproducible original and five copies.

2.0 STUDY BACKGROUND

2.1 Community Background

The Community of Rigolet is located on the coast of Labrador at the mouth of Lake Melville approximately 160 km east of Happy Valley-Goose Bay, latitude $54^{\circ} 10' N$; longitude $58^{\circ} 25' W$ (Figure 1).

The Community had a population in the 1981 census of 271. Access to the Community is by sea or air only. The Community has a gravel airstrip which is still under construction. It is serviced by Labrador Airways with regularly scheduled flights three times per week using either the airstrip with wheeled aircraft, the harbour by float plane, or by ski plane on the lake as weather conditions dictate. Marine access is solely by scheduled Canadian National coastal boats during the shipping season which normally extends from late June to mid November. The service operates on a 7 - 10 day return basis originating in Lewisporte on the Island of Newfoundland.

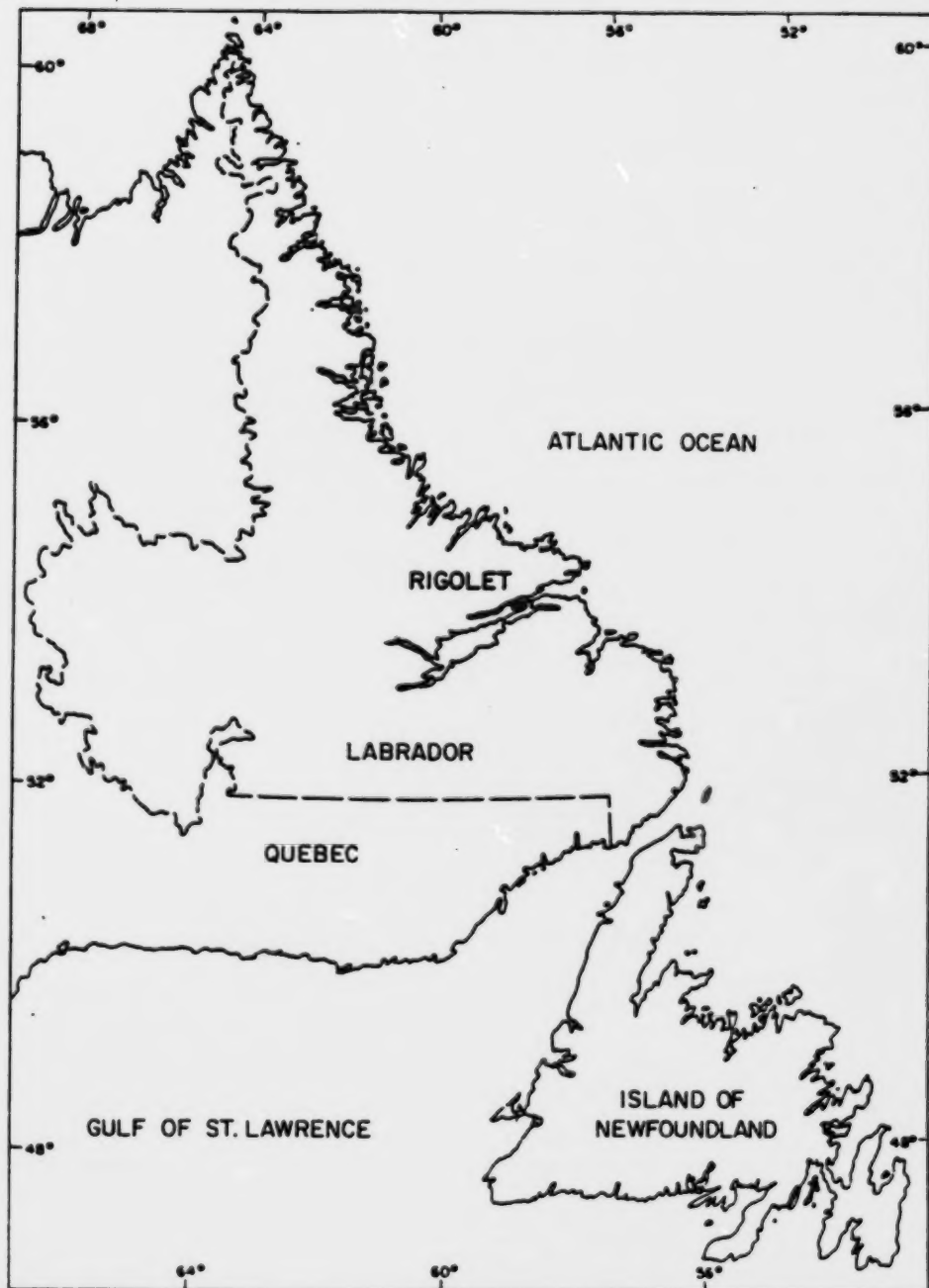
2.2 Climate

Rigolet is considered to resemble more closely the Coastal Labrador Climatic Zone than the more continental climate of the interior (Banfield, C.E. Pers. Comm.). Average annual precipitation is approximately 940mm with average maximums occurring during the months of June, July and August. Mean daily temperature in February, April, July and October are $-14^{\circ}C$, $-2^{\circ}C$, $14^{\circ}C$ and $3^{\circ}C$ respectively. The freezing index is 40,000 $^{\circ}C$ hr.

2.3 Geology

1:100,000 geological mapping conducted by the Newfoundland Department of Mines and Energy in 1980 in the Rigolet region has shown that Rigolet and immediate vicinity is underlain by pale to mid grey weathering, medium grained (2-3 mm) biotite hornblende quartz diorite. This rock has a foliated to gneissic appearance and contains light coloured quartzofeldspathic segregations making up about 10-15% of the rock. The rock has been intruded by later rectiplanar pegmatite. The foliations in the area define a northwest-plunging synform.

Figure 1
LOCATION PLAN



2.4 Vegetation

The development site and drainage area is entirely located within 3 km of the ocean. As is typical of this part of coastal Labrador the vegetation consists of sparse forest cover and bogs or barrens. The trees are predominantly black spruce (*Picea Mariana*) and balsom fir (*Abies Balsamea*) averaging less than 5 metres in height. The bogs and barrens have very low vegetal growth consisting primarily of moss, lichens and shrubs.

2.5 Manpower and Equipment Availability:

Canada Manpower has indicated that the labour force in Rigolet is approximately 40 - 45 persons.

Due to the nature of the work to be undertaken and the construction methods to be employed only those persons skilled in the operation of heavy construction equipment or the various trades are likely to gain employment during the construction of the project. At present there are three (3) heavy equipment operators, two (2) journeymen electricians and ten (10) carpenters registered with Canada Manpower and living in Rigolet.

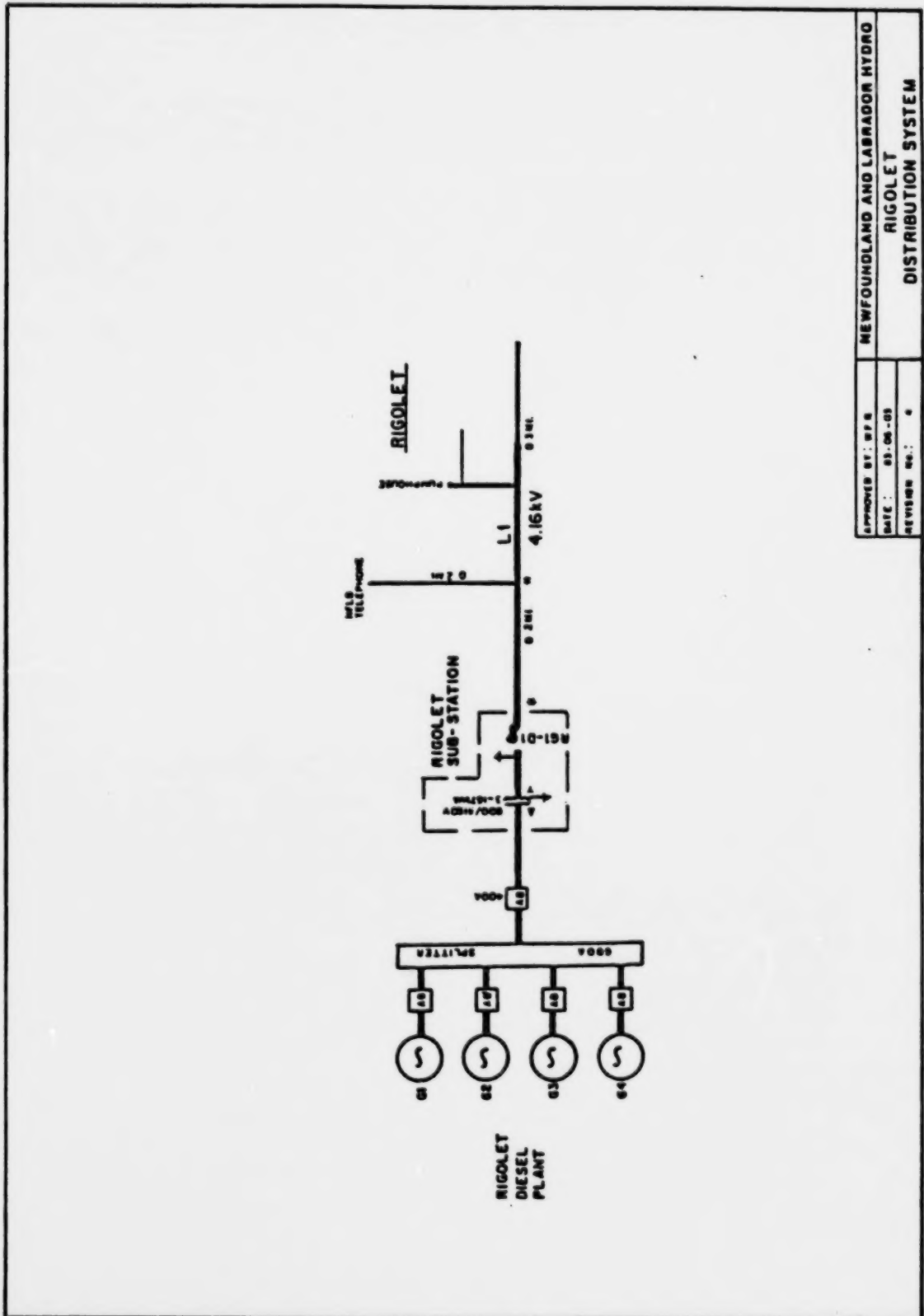
No heavy construction equipment is presently available in Rigolet for use on this project.

2.6 Existing Generation System and Power Requirements

Rigolet is presently served by a diesel generation plant consisting of one 60 kw unit, one 134 kw unit and two 250 kw units (Figure 2). The forecasted load for this Community shows that no additional capacity will be required for the 30 year forecast period. The plant served the following customers in December, 1983:

<u>RATE CODE</u>	<u>CLASSIFICATION</u>	<u>NUMBER OF CUSTOMERS</u>	<u>DESCRIPTION</u>
1.2	Domestic Diesel	76	Family Units, Churches and Schools
2.2	0-10 kw (hydro rate)	1	Fish Handling Facility
2.5	0-10 kw (Diesel)	8	Commercial & Institutional
2.5	10-100 kw (Diesel)	2	Commercial & Institutional
5.06	Area Lighting	<u>1</u>	Street Lights
Total		<u>88</u>	

Figure 2



APPROVED BY: W.P.B.		NEWFOUNDLAND AND LABRADOR HYDRO	
DATE: 01-08-05	REVISION No.: 0	RIGOLET DISTRIBUTION SYSTEM	

Growth rates for demand have been projected at 4.5% for 1984, 2.5% from 1985 to 1995 and 2.0% from 1995 to 2014. No exceptional new loads are predicted during the forecast period.

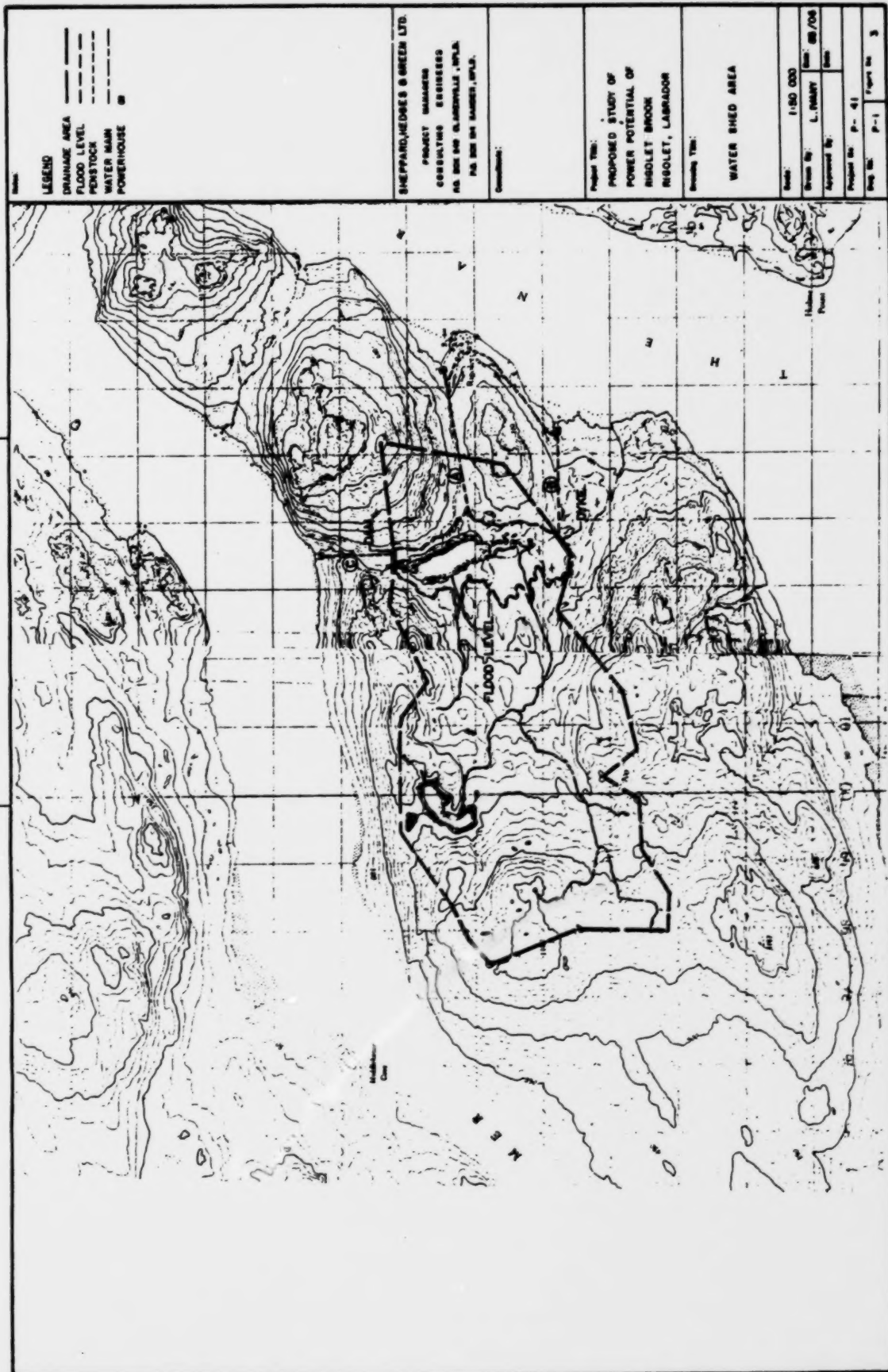
The annual kilowatt hour losses of approximately 7% was added to the annual kilowatt hour sales for each year to obtain the annual production forecast. This forecast is shown in detail in Appendix A and is summarized below:

<u>YEAR</u>	<u>DEMAND (MWH)</u>	<u>PEAK LOAD (KWH)</u>
1985	834	238
1990	938	268
1995	1053	301
2000	1159	331
2005	1275	364
2010	1404	401
2015	1546	442

2.7 Review of Proposed Alternative Schemes

Three alternative schemes were suggested in the original proposal (Figure 3). All three included a dam in the same location at the outlet of Rigolet Pond, creating storage of similar volume but each scheme involved a different penstock route, intake and power house location. Power output would not be significantly different for either scheme.

Schemes A and B were similar in that they both combined the water supply main with the penstock over much of the distance, however the lengths of penstock and water main varied with each scheme with scheme B requiring the construction of a much longer power transmission line, water main and road. Scheme C could not take advantage of combining the water supply main with the penstock and therefore could not take advantage of possible funds available by combining the two. This together with the much longer road and power transmission line cost eliminated scheme C very early in the investigation.



When larger mapping and site investigations had been completed it was realized that schemes A and B were, in effect, identical with the exception that for scheme B the penstock length was marginally shorter and the water supply main and power transmission line considerably longer. The cost saving in the shorter penstock was not sufficient to offset the increased cost of the longer water supply main and power transmission line required to connect to the existing systems.

The desired scheme therefore was the one identified as scheme A in the original proposal.

Since one main aim of this study is to assess the feasibility of combining a water supply system with a hydro electric project it is necessary to review all aspects of each combined facility where possible. Both projects combine many of the same elements; dam, intake, penstock/transmission main, access roads and power supply and this of course forms the basis of trying to combine the two into a joint project. Because the hydro project is much larger it was decided to assess all factors affecting the development of the hydro project and then review the water supply requirements in light of this.

3.0 HYDRO SCHEME TECHNICAL CONSIDERATIONS

3.1 Proposed Scheme

The selection of the proposed scheme was based on an evaluation of various alternative layout arrangements, dam heights, penstock and hydro unit size as they related to the functioning of the unique hydraulic system, its integration with the existing diesel generators as well as its ability to meet the projected demands in the most cost effective way (Drawing C-480-1-F16, Sheets 1 to 3).

The proposed arrangement contains the following components:

- (1) 2.6 metre high rock fill dam with impervious synthetic membrane liner.
- (2) Intake structure with propeller pump feeding the penstock.
- (3) Partially shallow buried and partially deep buried penstock which acts as a siphon.
- (4) Powerhouse with two (2) impeller turbines and one (1) electronic load governor.

Water is fed to the turbines through a 610mm diameter 2480 metre long penstock by a propeller pump located in a vertical intake pipe. The penstock is a siphon and the pump is used to add head at the intake thereby reducing the siphon head and consequently the negative pressures at the high point in the siphon.

The turbines will operate under steady state conditions with load changes accommodated by an electronic load governor rather than gates, enabling the flow to the turbines to remain constant and thereby eliminating hydraulic transients in the penstock.

The system has been sized to meet as closely as possible the demand during the months from May to November, and the available flow from inflow and storage during the months from December to April consistent with the most economical penstock size and dam height.

3.2 Geological and Geotechnical

No formal geological or geotechnical investigations were undertaken at the site of the proposed structures, however certain information is available from other sources, from subsurface probings and surface observation.

The dam and spillway is located in a north-south direction across the valley through which the outlet brook flows. Solid rock outcroppings are visible at both ends of the proposed structure and at several locations throughout its length. The rock has few visible fractures and should provide an adequate foundation for the rockfill dam. The overburden consists primarily of bog and other organics which are unsuitable for use elsewhere in the project.

All other structures, with the exception of the intake, will be constructed in a saturated silty sand which is a very poor foundation material except in the dry undisturbed state (Figure 7). Unfortunately, the groundwater table is either at or near the surface in all locations so that extreme care will be required in excavating and placing foundations in this material. Where practical, geotextile fabrics will be used for soil stabilization and separation purposes.

Because of the nature of the underlying material, access roads will be constructed on a woven geotextile blanket over undisturbed ground thereby avoiding interaction with the unstable soil. Non woven geotextiles should be used to line trenches to separate existing silty soil from imported pipe bedding and backfill.

Site investigations revealed a pit approximately 2.0 km west of the Community with an adequate supply of good, clean sandy gravel suitable for pipe bedding, backfill, road construction material, and protective backfill for the rockfill dam.

3.3 Hydrology

The drainage area determined by planimetry from 1:50,000 scale topographic maps is 22.89 square kilometers.

Flow records for Rigolet Brook were not available and it was therefore necessary to synthesize monthly flows from the nearest gauged river. Eagle River (Sta. 03QC001) with a drainage area of 10,900 km² has the longest period of record of any in the area. Synthesis of flow records was based on single drainage area proration and is shown in Appendix B. While the drainage area of Eagle River is much larger than Rigolet Brook, introducing the possibility of significant errors, it is the only river in the area with a significantly long period of record.

A comparison of Eagle River with Alexis River which has a much smaller drainage area and period of record by Newfoundland and Labrador Hydro, in the St. Mary's River Mini Hydro Study, yielded very similar results, indicating that the same flow regime existed despite large differences in the drainage areas and location. The greatest concern with a small drainage area is that there might be periods of no flow during the dry months. Interviews with residents of the Community indicate that this is not the case with Rigolet Brook. In fact, residents now get their water in winter from the outlet of Rigolet Pond which they say never freezes, leading one to conclude that indeed a significant flow is maintained in Rigolet Brook during the winter months.

The creation of storage will also help to reduce the effect of errors caused by the lack of information from gauged rivers of a similar size except in the months of January to April when all of the anticipated river inflow plus available storage will be required to maintain the required flow to the turbines.

The following data has been derived from the analysis to be applied to the catchment area:

(1) Mean Annual Specific Run-off	0.0247 m ³ /s/km ²
(2) Ratio between Mean Annual Peak Flood Discharge and Mean Annual Flow	16.59
(3) Ratio between 1 in 100 Year Peak Flood Discharge and Mean Annual Flood Discharge	2.2

For Rigolet Brook, the specific parameters adopted are summarized as follows:

(1) Drainage Area	22.89 km ²
(2) Mean Annual Flow	0.57 m ³ /S
(3) 1 in 100 Flood Peak Discharge	20.80 m ³ /S

3.4 Hydraulics

The hydraulic system consists of an intake with a pump pumping to a penstock which operates as a siphon. The turbines operate under a steady flow condition which is adjusted twice annually. The steady state flow prevents hydraulic transients and large negative pressures from occurring in the penstock. Negative pressures are restricted to a maximum of - 7.6 metres to limit the possibility of cavitation in the piping.

The penstock can operate as a true siphon (without pumping) during the months of May through December when the reservoir is at FSL. It is capable of delivering a steady state flow of $0.40 \text{ m}^3/\text{S}$ to the turbines under a head of 34.4 metres for the months of May to November. From December to April the flow is reduced to $0.31 \text{ m}^3/\text{S}$ and the level in the reservoir will steadily decrease from a FSL of 44.5 metres to a LSL of 40.5 metres.

A 20 kw pump will be required from January to April to maintain a constant head and flow at the turbine. This can be accomplished by selecting a propeller pump with adjustable blades which would be adjusted as required to maintain the correct head and flow, by adjusting the speed of the pump or by throttling with a valve. A pump manufacturer would be asked to design a pump which would meet these requirements. A Flygt propeller pump similar to the one shown in Figure 4 would be suitable.

The presence of the pump would ensure that the system would always function even if the true siphon could not, for some reason, be maintained.

A smaller pump which would be capable of overcoming the maximum head of the siphon would also be required to charge the penstock and maintain flow to the Community in the event of failure of the propeller pump.

A vacuum pump and access point would be required at the high point of the siphon in order to periodically purge the line of entrapped air.

3.5 Civil Works

The civil works comprise by far the largest portions of the project and consist of the dam, access roads, intake structure, penstock, powerhouse, power transmission line and tail-race improvements.

.1 Dam

The dam and spillway structure is located on Rigolet Brook at the outlet from Rigolet Pond, approximately 3.5 km northwest of the Community (Drawing C-480-1-F16, Sheets 1 and 3).

The structure will be a rockfill dam with an impervious synthetic membrane covered with a protective layer of sand and blasted rock on the upstream face (Figure 5).

The total length of dam is 310 metres including a 120 metre long overflow spillway. The average dam height is 2.6 metres with a maximum elevation of 44.7 metres and a spillway elevation of 44.5 metres.

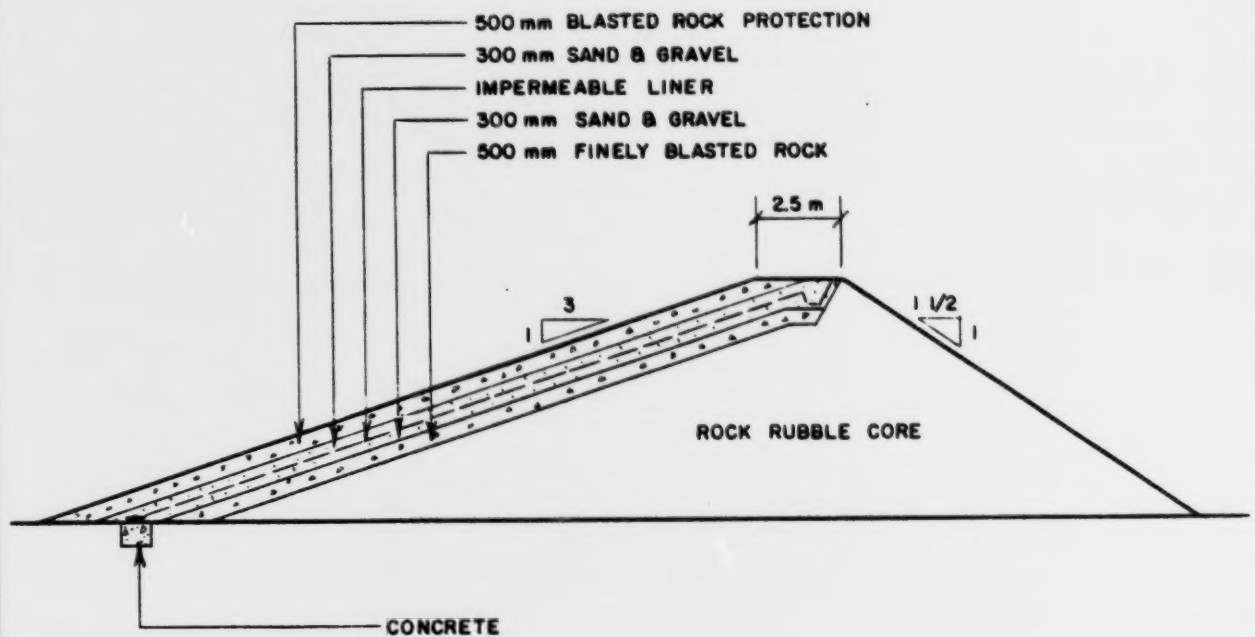
Dewatering will be accomplished by excavating a diversion channel through the overburden on the north side of the river and installing a culvert in Rigolet Brook. A cofferdam will be used to close off the river section until that area is completed. Construction of the dam can then proceed from the south end of the dam to the diversion. The cofferdam can be removed at the river and the diversion blocked to complete the remainder of the dam. The culvert will be equipped with a steel gate which would be closed when work is completed on the entire dam. This could be used in future to drain the reservoir if required to make repairs to the dam.

.2 Intake

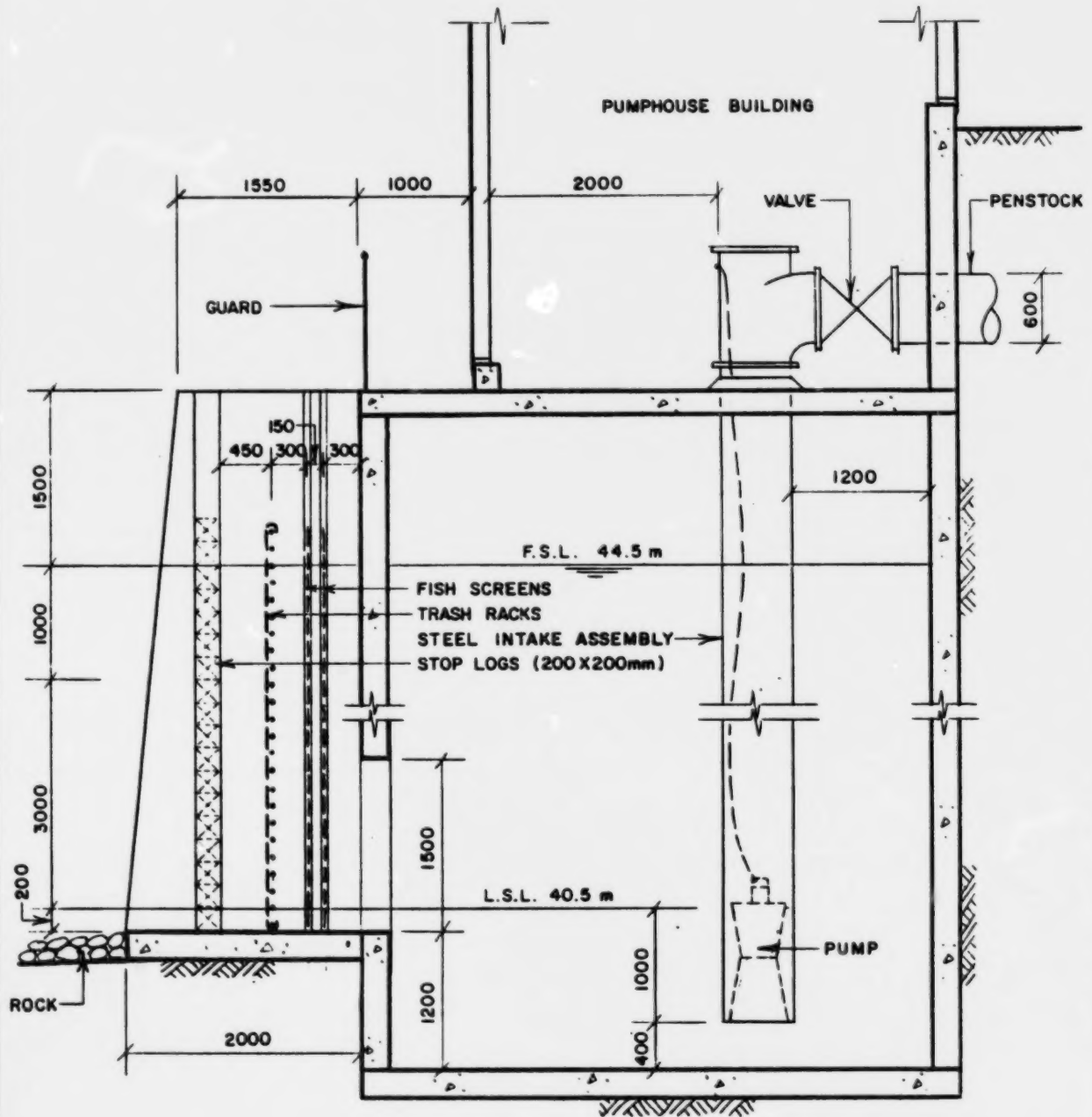
The intake structure is located on the south side of the Pond. It will consist of a building on a reinforced concrete foundation (Figure 6). The foundation will serve as a wet well which will house a steel intake pipe and submersible propeller pump. Access for installing and removing the pump will be by means of a tee at the top of the vertical intake pipe located on the upper level of the intake building. The intake structure will also house the pump controls and a smaller pump for maintaining flow to the Community when the larger pump is out of service.

The water entrance to the wet well will be equipped with trash racks to prevent the entrance of debris and double layer screens to prevent the entrance of fish (Appendix D).

Dewatering for construction of the wet well will be accomplished by constructing a cofferdam around the intake structure site.



PROJECT TITLE	SHEPPARD, HEDGES & GREEN LIMITED	
	SCALE	NTS
DRAWING TITLE	DRAWN BY	C. P. WAY
	DATE	84 - 11
	FIGURE NO.	5
RIGOLET MINI-HYDRO STUDY		
DAM SECTION		



PROJECT TITLE

RIGOLET MINI-HYDRO STUDY

SHEPPARD, HEDGES & GREEN LIMITED

SCALE

NTS

DRAWN BY

C. P. WAY

DRAWING TITLE

INTAKE STRUCTURE SECTION

DATE

84 - 11

FIGURE NO.

6

.3 Power Transmission Line

Very little work will be required to connect the generator into the existing grid since the powerhouse is located near the centre of the Community adjacent to existing power lines.

The power supply for the pump however will require the upgrading of 1.0 km of powerline from the Community to the airport building from single phase to three phase and the construction of 1.2 km of new 600 V, 3 Phase, 60 Hz. power line from the airport building to the intake.

.4 Penstock

The penstock runs in a north-south direction from the intake to the Community paralleling the airport runway.

The penstock will be 2480 metres long, 610 mm in diameter and be constructed in 12 metre lengths. It will be of fibreglass reinforced plastic (FRP) construction with double O-ring bell and spigot joints capable of withstanding the negative pressure conditions required. It will be connected to the existing water supply piping within the Community by means of a 150 mm tee and gate valve approximately 60 metres north of the powerhouse.

Excavation and backfill for penstock installation will be carried out using normal trenching and pipe installation methods and equipment. Excavation will be entirely in common material, however it is complicated by the fact that the common material has a very high silt content (Figure 7) and the groundwater table is at the ground surface throughout most of the penstock length. To help simplify trenching and pipe installation, the pipe will be shallow buried wherever possible and deep buried only where necessary to reduce the siphon head (Figure 8).

Separation of trench backfill from in-situ silty sand and improved drainage will be ensured by installing a non-woven geotextile in the trench bottom, covered with 150 mm thick sand bedding. The pipe will be backfilled with sand and gravel to a distance of 150 mm above the pipe. The remainder of the trench will be filled with excavated material which will also be mounded over the top to provide added insulating value.

FIGURE 7

GRAIN SIZE DISTRIBUTION

SOIL SAMPLE DESCRIPTION:

Silty Sand (SM)

**GOLDER ASSOCIATES
TESTING LABORATORIES**

LOCATION: ..RIGOLET..
PROJECT: ...811-5062

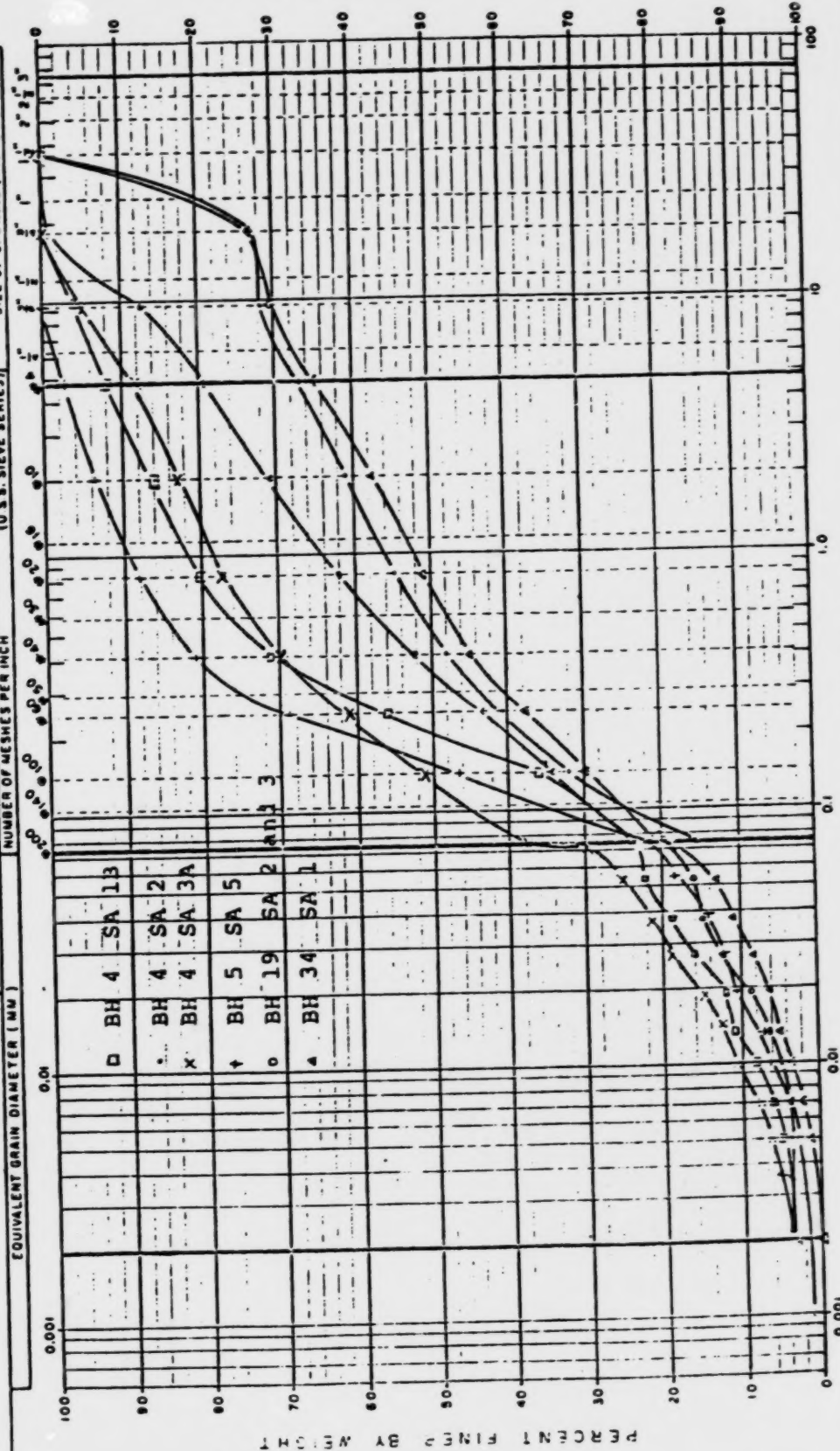
BORE HOLE NO. _____ **SAMPLE NO.** _____

LAB. NO.

DATE: 09/10/81

CHECKED BY: DWH DATE: 31/10/81

CHECKED BY	SERIES	SIZE OF OPENING (INCHES)
J.P.		



GRAIN SIZE (MM)

SILT SIZE

PINE

SAND SIZES

SIZES

CLASS

GR

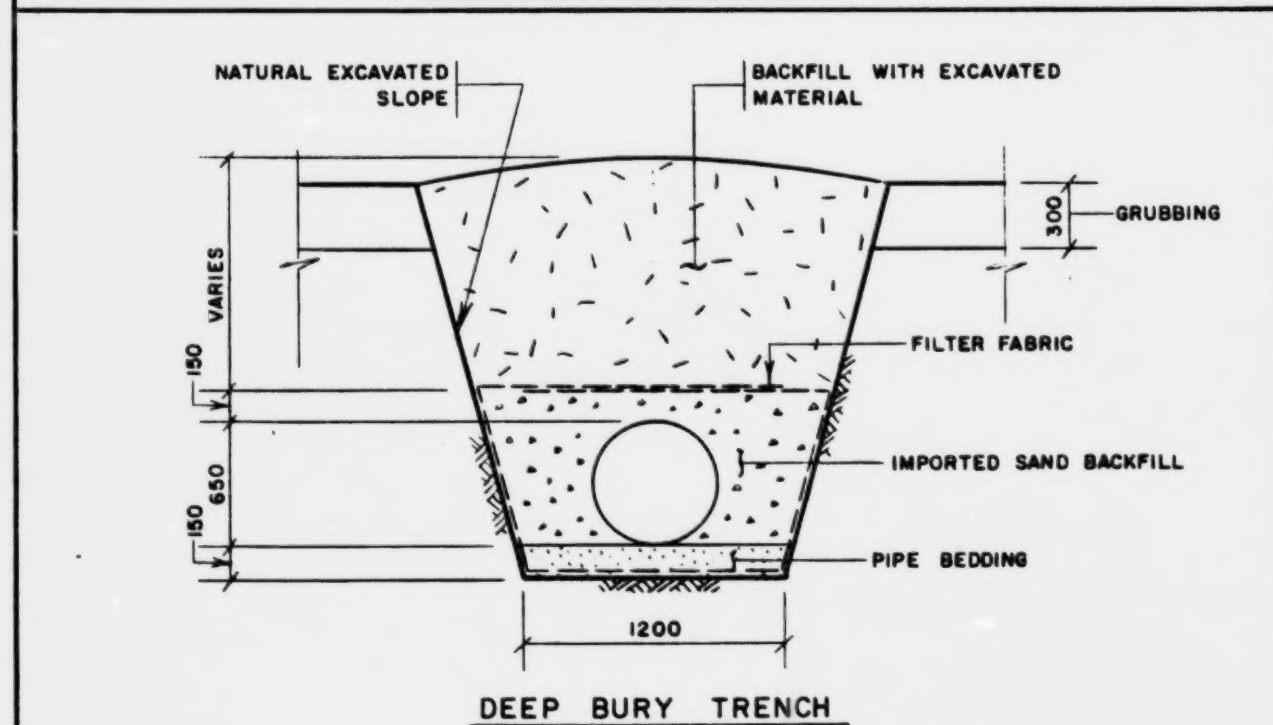
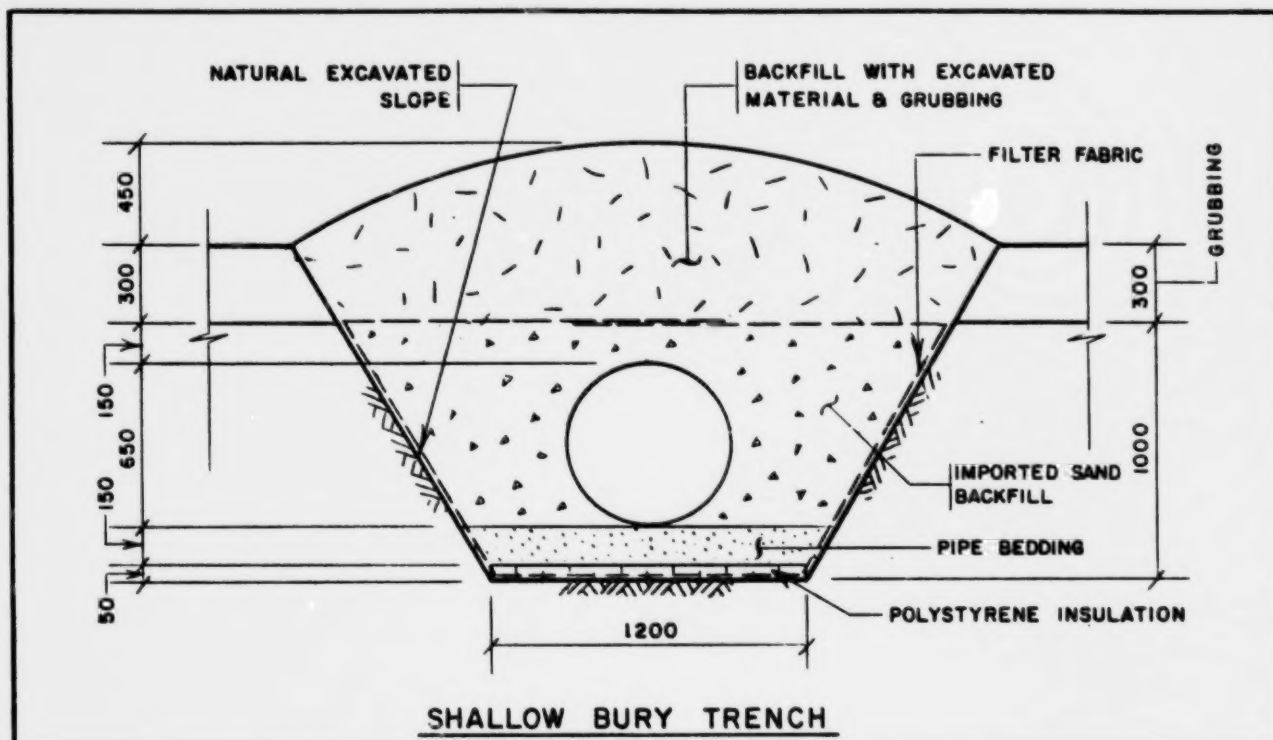
SIZES

SIZES

COBAL

CLAY
SIZE

REMARKS



PROJECT TITLE RIGOLET MINI-HYDRO STUDY	SHEPPARD, HEDGES & GREEN LIMITED	
DRAWING TITLE PIPE TRENCH DETAILS	SCALE	NTS
	DRAWN BY	C. P. WAY
	DATE	84 - 11
	FIGURE NO.	8

Frost heaving of the pipe in areas of shallow bury will be prevented by installing a 50 mm layer of sheet polystyrene insulation beneath the pipe (Figure 7) to prevent freezing of the underlying soil. Damage to the shallow buried pipe by frost action above the pipe will be prevented by back-filling the pipe with clean sand.

Dewatering, where required, will be by means of Contractor's pumps.

.5 Access Roads

From the Community to the northern end of the runway the existing roads or the runway will be used as the means of access for construction of the pipeline. New access roads will be required from the north end of the runway to the intake and from the intake to the dam, a total distance of 2.5 km.

Roads will be constructed of locally available sand and gravel fill, 4.0 metres wide by 450 mm thick, over a blanket of woven geotextile fabric placed on original ground (Figure 9).

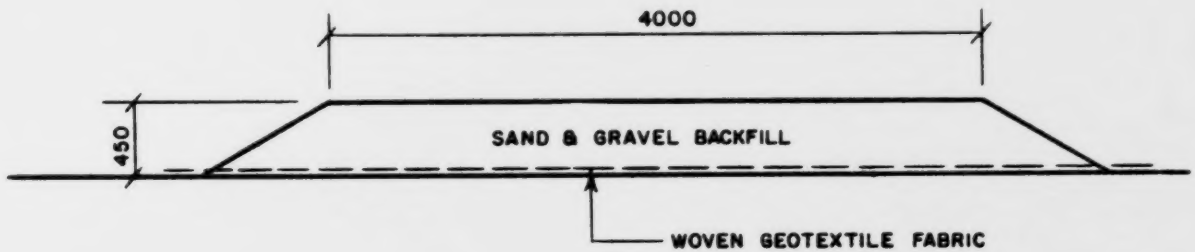
.6 Powerhouse

The powerhouse is located near the centre of the Community adjacent to a small brook approximately 70 metres from the point where the brook enters the harbour.

The powerhouse consists of a reinforced concrete substructure topped with a building which houses the turbines and generator. The substructure measures 5.0 metres long by 3.0 metres wide by 2.5 metres deep with a 2.0 metre extension downstream. The building will be of conventional construction measuring 5.0 metres by 5.0 metres.

.7 Tailrace

The tailrace will consist of a 70 metre long by 3 metre wide channel excavated to the high water mark in Rigolet Harbour. Culverts will be required where a local road crosses the tailrace. Gabion baskets will be used to form the sides of the tailrace between the powerhouse and the culvert and a gabion blanket used to line the bottom of the channel to prevent erosion of the unstable soil.



PROJECT TITLE RIGOLET MINI-HYDRO STUDY	SHEPPARD, HEDGES & GREEN LIMITED	
	SCALE	NTS
DRAWING TITLE ACCESS ROAD CROSS SECTION	DRAWN BY	C. P. WAY
	DATE	84 - 11
	FIGURE NO.	9

3.6 Mechanical Equipment

The mechanical equipment consists of one (1) 20 kw propeller pump pumping to two (2) impeller type turbines, and one (1) 2 kw pump to charge the penstock and maintain flow to the Community when the large pump is out of service. The turbines operate under steady state flow conditions with no mechanical flow regulation. The turbines are sized in accordance with the two (2) steady state flow conditions they are required to handle. The larger turbine is designed to handle a flow of 0.31 m^3 per second under a head of 35.5 metres which corresponds to the steady state flow for the months of December through April. The smaller turbine is designed to handle a flow of 0.09 m^3 per second under a head of 34.4 metres. Both turbines would operate during the period from May to November at a combined flow of 0.40 m^3 per second and at a head of 34.4 metres.

The pump will not operate during the summer months but will be required to add average monthly heads varying from 0.4 metres to 3.1 metres during the winter months in order to maintain the required head and flow to the turbines.

3.7 Electrical Equipment

The electrical equipment consists of a 125 kw alternator, control panel and electronic load governor. The system is designed to produce 600 volt, three phase, 60 Hz. power.

The electronic load governor will regulate the system by maintaining a constant load on the system without altering the flow to the turbines. It accomplishes this by dumping the load into a resistor bank when it is not required and withdrawing it when demand increases.

3.8 Capacity and Energy

The purpose of the capacity and energy analysis was to determine the nominal installed capacity and the average annual energy for each year from 1986 to 2015.

Flow duration data was derived from monthly average flows. The turbines were sized by optimizing dam height and penstock size based on incremental costs, available flows and power utilization.

Inquiries with turbine manufacturers indicated that the most economical solution was to use two (2) impeller turbines which would function under constant head and constant flow. The larger turbine would be sized to meet the available winter flow of $0.31 \text{ m}^3/\text{S}$ from inflow and storage and the smaller unit sized for $0.09 \text{ m}^3/\text{S}$ which is the additional flow that could be accommodated in the penstock and still enable it to operate as a pure siphon (without pumping). This provided a power output corresponding to the average summer demand midway through the forecast period. Making allowance for larger flows which might be possible under ideal flow conditions during spring and fall a nominal installed capacity of 125 KW was selected.

The average annual hydro energy produced each year from 1986 to 2015 was then determined from the net of hydro power generated less power required for pumping considering as well that for some months during the first half of the 30 year forecast period all the energy generated by the turbines could not be utilized.

Because the system will operate under two (2) conditions of constant flow the "Flow Use Factor" is 1.0. The effect of load fluctuation was compensated for to some degree by the use of a "Load Use Factor" taken from a curve of "Load Use Factor" versus "Relative Power Potential" produced by Shawmont Newfoundland Limited in "Study of Small Scale Hydro for Newfoundland and Labrador" and shown in Appendix C.

The system net heads and required pump heads were derived from field survey information and by using standard engineering formula to compute head losses.

The parameters used for energy calculations are as follows:

F.S.L.	44.5 metres
L.S.L.	40.5 metres
Max. Plant Flow	$0.4 \text{ m}^3/\text{S}$
Min. Plant Flow	$0.31 \text{ m}^3/\text{S}$
Tailrace Elevation	4.8 metres
Head losses at F.S.L.	5.3 metres
Head losses at L.S.L.	3.5 metres
Ice Formation:	Nil in May to Dec.
	Ave. 0.5 metres in Jan. & Feb.
	Ave. 1.0 metres in Mar. & April
Overall efficiency	77%
Net heat at F.S.L.	34.4 metres - May to Nov.
Net Head at L.S.L.	35.5 metres - Dec. to April

Power required for the pump when used for additional head to keep maximum negative pressure in penstock within allowable limits is 3 KW to 16 KW - yearly 39 KW.
Energy for pump - 28 MWH.

The useable energy output of the development is summarized in Table 3.1 and is shown in detail in Appendix C.

3.9 Environmental Considerations

The purpose of the environmental review is to assess resource conflicts in light of the proposed mini hydro/water supply development. Very little data is available so that the assessment is based primarily on interviews and discussions with various resource agencies. Because of the size of the project it will not be necessary to register it under the Environmental Assessment Act.

The greatest impact on the environment will result from the construction of the dam, the flooding of the reservoir and the creation of "no flow" conditions in the river during the months of November to April.

.1 Reservoir Area:

The reservoir surface area will be increased from 0.58 km² at present to 1.00 km² at full supply level. The flooding of the reservoir will result in the flooding and loss of 42 ha. of land at full supply level. Approximately 10 ha. of this is marginal forest stand of black spruce and balsom fir. The remaining flooded area is primarily bog or barren.

The area to be cleared has limited use as fire wood only and will not be a significant loss since the salvaged wood can be utilized by local residents.

.2 Fish:

Rigolet Brook supports a small population of anadromous salmonid which migrate from the ocean up to Rigolet Pond where they spawn.

Since there is no room for mitigating the effects of this project on fish habitat and because the fish population is so small and the watershed is not utilized to a large extent by the local residents for angling, the Department of Fisheries and Oceans has agreed that the project can be constructed without mitigation other than that required during the construction process and screens to be placed at the intake (Appendix D).

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TABLE 3.1
RIGOLET MINI-HYDRO

SUMMARY POWER AND ENERGY STUDY

(1) Year	(2) Forecast Energy (MWH)	(125 KW UNIT)		(5) Total Hydro Energy (MWH)	(6) Net Hydro Energy (MWH)	(7) Total Diesel Energy (MWH)
		(3) Pump Energy Required (MWH)	(4) Total Energy Required (MWH)			
			(2 + 3)		(5 - 3)	(4 - 5)
1986	817	28	845	708	680	137
1987	838	28	866	716	688	150
1988	859	28	887	723	695	164
1989	880	28	908	729	701	179
1990	901	28	929	736	708	193
1991	924	28	952	745	717	207
1992	947	28	975	753	725	222
1993	971	28	999	762	734	237
1994	996	28	1 024	767	739	257
1995	1 016	28	1 044	770	742	270
1996	1 035	28	1 063	773	745	290
1997	1 057	28	1 085	777	749	308
1998	1 077	28	1 105	780	752	325
1999	1 099	28	1 127	784	756	343
2000	1 122	28	1 150	789	761	361
2001	1 144	28	1 172	793	765	379
2002	1 167	28	1 195	797	769	398
2003	1 190	28	1 218	800	772	418
2004	1 214	28	1 242	805	777	437
2005	1 238	28	1 266	809	781	457
2006	1 262	28	1 290	813	785	477
2007	1 288	28	1 316	818	790	498
2008	1 314	28	1 342	820	792	522
2009	1 340	28	1 368	822	794	546
2010	1 367	28	1 395	822	794	573
2011	1 395	28	1 423	823	795	600
2012	1 423	28	1 451	824	796	627
2013	1 451	28	1 479	825	797	654
2014	1 480	28	1 508	826	798	682
2015	1 510	28	1 538	828	800	710

.3 Historic Resources:

Existing information indicates that there are no historic sites in the project area. Should any be discovered it will be necessary to carry out further investigations at that time (Appendix D).

.4 Wildlife:

Wildlife is very limited in the proposed project area because of habitat restrictions and heavy hunting pressure (Luttich pers. comm.). Few, if any, big game would be found and small game would simply adjust to accomodate the new higher shoreline of the reservoir. There will therefore be minimal impact on wildlife as a result of this development.

4.0 WATER SUPPLY SYSTEM

The development of a water supply system requires the construction of all the facilities required for the hydro project with the exception of the powerhouse and tailrace, however on a smaller scale. As well most of the regulations imposed by the approving agencies apply equally to both projects.

The only additional work required for the water supply that would not be needed for the hydro project is the connection to the existing water supply piping and the reconstruction of the existing chlorination system.

The water supply would be designed as a domestic water supply only and operate as a constant pressure pumping system.

The facilities required for the water supply system are described as follows:

4.1 Dam

The dam structure would be of identical construction to the hydro dam except that the dam elevation would be 2.5 metres lower at elevation 42.2 metres.

Construction of the dam would proceed in an identical manner to the hydro dam.

4.2 Intake

The intake structure would be identical except that it could be smaller since it would only be required to accommodate two (2) 2 kw submersible pumps sized to meet peak water supply demands.

4.3 Power Supply

The power supply required for the water supply pumps could be obtained by constructing a single phase power transmission line from the end of the existing line at the airport building to the intake, a distance of 1.5 km.

4.4 Water Supply Main

The water supply main would be constructed along the same route as that chosen for the penstock with the length being approximately 60 metres shorter or 2420 metres in length. The pipe diameter would be 150mm as opposed to 610 mm for the penstock.

Because of the much smaller flows in the water supply main and the low flow conditions which would exist during the right time, it would be necessary to either deep bury the water pipe throughout the entire distance or shallow bury an insulated pipe.

Since ground conditions are the same as for the hydro scheme, identical construction methods and ground stabilization techniques would be used.

4.5 Access Roads

The identical length and design for access roads would be required to construct the water supply system as would be used in the hydro project.

5.0 COST ESTIMATES

5.1 Methodology

Cost estimates were prepared using quantities computed from centre line profiles, structure sketches and 1:10,000 mapping. Estimates are prepared on the basis of costs anticipated in the 1985 construction season using airport construction costs and costs for similar earthwork projects carried out elsewhere in Coastal Labrador as guidelines.

Budget quotations were obtained from suppliers for items such as pumps, piping and turbines (including generator and control package).

It was assumed that most labour and all equipment and materials other than gravel and rock would have to be brought into Rigolet.

5.2 Engineering and Construction Management

An allowance of 18% to cover engineering, investigations, surveys, planning, procurement and construction management has been estimated. This agrees with costs being encountered by the Department of Municipal Affairs on similar pipeline projects on Coastal Labrador.

5.3 Contingency

Contingency is the estimated allowance to cover undefined costs that will be identified between the preliminary appraisal stage and the final approval stage. It is the aggregate of a number of variables including the extent of field investigative work and engineering refinement, logistic factors, the sensitivity of construction, manufacturing and labour markets, the effect of regulatory agencies such as environment, and the climatic and field conditions encountered.

Due to the availability of engineering survey data and good confidence in structure location a relatively low allowance (10%) has been used.

5.4 Escalation, Interest during Construction, Corporate Overhead

(a) Escalation

Escalation is the cost included to anticipate the effect of future inflation in the forecast final cost of the project. Estimates have been prepared in 1985 dollars. That portion of the cost to be incurred in 1986 has been escalated by 5.41 percent, the estimated inflation rate for work of this type for 1985-86. This escalation rate was provided by the Economic Analysis Department of Newfoundland and Labrador Hydro.

(b) Interest during Construction

Funds to finance this project would be derived from three (3) sources; Department of Municipal Affairs, in the form of a grant or guaranteed loan to the Community; Energy Mines and Resources Canada, in the form of a grant; and funds derived from future savings in fuel costs by Newfoundland and Labrador Hydro.

Interest during construction would not be a consideration in the Department of Municipal Affairs' funding since it is normally capitalized as part of the total cost of the project and added on later. It is anticipated that the same would apply to this project. Energy Mines and Resources funds would be in the form of a grant which is assumed would be paid "up front" so that again interest during construction would not be a consideration. The only portion of the cost subject to interest during construction would be that to be financed by the project itself. To minimize this cost the last items to be constructed or installed could be financed with this portion of the funds. The proposed construction cost schedule (Figure 10) shows that a significant portion of the work will be carried out in the last two (2) months which means that interim financing and therefore interest during construction should be kept to a minimum. Interest during construction has therefore been estimated at only 2% of the direct construction cost.

(c) Corporate Overhead

Corporate overhead is a percentage levy applied against projects to recover a proportionate share of corporate costs incurred by the owner but not specifically identified elsewhere.

Regardless of whether or not the project was eventually developed by Newfoundland and Labrador Hydro or some other agency such as the Community of Rigolet who would sell the power to Hydro these costs will be incurred and must be recovered from the project.

Because most of the funding for the project will come directly from governments, and since the amount to be financed will be small in relation to most hydro projects, much of the work normally covered by corporate overhead, such as the arranging of financing, will be either eliminated or considerably reduced.

Corporate overhead has therefore been included at a relatively low value of 2% of direct construction cost.

5.5 Water Supply Cost Estimate

All aspects of the water supply, with the exception of some minor items such as the second submersible pump and connection to the existing piping are common to the hydro project.

Estimated cost for an independent water supply system in 1986 dollars is as follows:

(1) Access Roads	\$ 100,000.00
(2) Power Supply	80,000.00
(3) Dam	160,000.00
(4) Intake	60,000.00
(5) Pipeline	560,000.00
(6) Chlorination System	60,000.00
	\$1,020,000.00
Eng. & Const. Mgmt.	180,000.00
	\$1,200,000.00
Contingency	100,000.00
Escallation	50,000.00
Total:	<u>\$1,350,000.00</u>

5.6 Combined Hydro Project/Water Supply Costs

The capital cost of the mini-hydro development, if built independent of the water supply is almost identical with the cost of including the water supply requirements.

Estimated cost for the combined scheme in 1986 dollars is as follows:

(1) Access Roads	\$ 100,000.00
(2) Power Supply	155,000.00
(3) Dam & Reservoir	375,000.00
(4) Intake	80,000.00
(5) Penstock	1,020,000.00
(6) Powerhouse	150,000.00
(7) Tailrace	40,000.00
	\$1,920,000.00
Eng. & Const. Mgmt.	345,000.00
Corporate Overhead	40,000.00
Int. during Const.	40,000.00
	\$2,345,000.00
Contingency	192,000.00
Escallation	93,000.00
Total	<u><u>\$2,630,000.00</u></u>

6.0 ENGINEERING AND CONSTRUCTION SCHEDULE

The schedule of engineering and construction shown in Figure 10 indicates a project completion date of October 1, 1986, based on a project release date of June 1, 1985. Actual construction will take only four (4) months, however engineering, equipment deliveries and winter down time extends the time frame to a total of sixteen (16) months from approval to power on. If the approved date could be moved ahead significantly it is possible that the civil works could be completed during the 1985 construction season and the turbines installed in late 1985 or early 1986.

The project should be tendered in three (3) packages:

(a) Contract # 1:

The design supply and installation supervision of the turbine-generator unit, control panel and electronic load governor. The value of this contract is approximately \$105,000.00.

(b) Contract # 2:

Contract # 2 includes the access roads, intake, dam, penstock, tailrace and powerhouse including installation of all mechanical and electrical equipment and connection to the existing power grid. Value of this contract is approximately \$1,660,000.00.

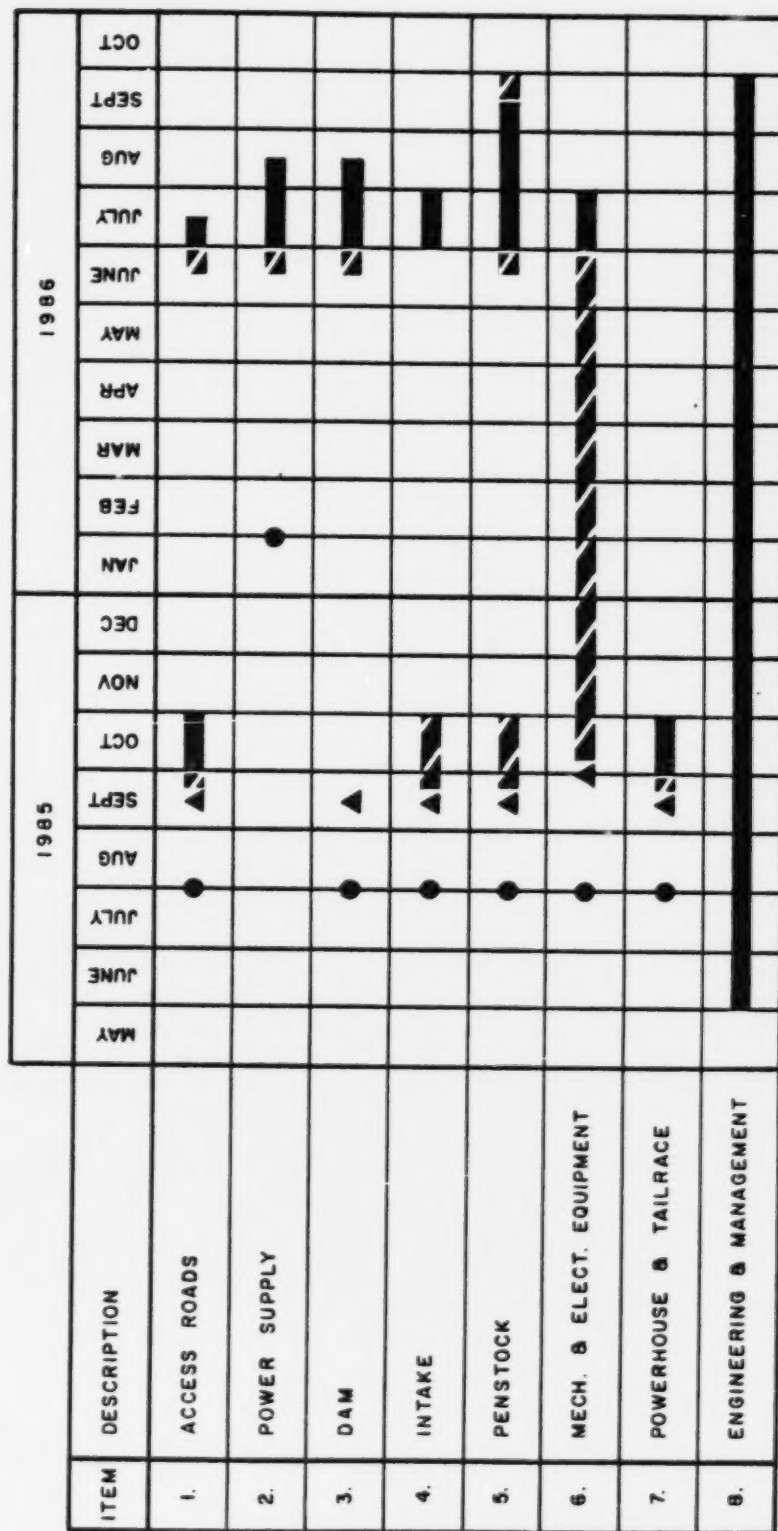
(c) Contract # 3:

Contract # 3 includes the supply and installation of the power transmission line from the airport building to the intake and the upgrading of the transmission line from the airport building to the Community. Value of this contract is approximately \$155,000.00.

RIGOLET MINI-HYDRO - CONSTRUCTION SCHEDULE

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Figure 10



● TENDER DATE
 ▲ AWARD CONTRACT
 ▨ EQUIPMENT DELIVERY, MOBILIZATION, ETC.
 ■ ACTUAL WORKING TIME

7.0 PROJECT EVALUATION

7.1 Methodology

The method used here to compare the cost effectiveness of the generation alternative is to compare on a present worth basis the incremental investment and system operating costs for each alternative. For a particular discount rate, the preferred alternative is the one with the lowest present worth cost.

The two alternatives considered are:

- the existing generation plant at Rigolet with a total installed capacity of 694 kw;
- the existing generation plant plus a 125 kw mini hydro plant to be installed in 1986.

Both alternatives are costed using the same load forecast for a period of 30 years. The capital cost used in the analysis is the total capital cost of the combined mini hydro and water supply project. The amount of external funding required to make the joint project feasible on 5, 10 and 15 year bases is determined using the formula:

Additional funding =

$$\frac{(\text{PW Costs, Hyd-Dsl Alt.} - \text{PW Cost Dsl Alt.}) \text{ year (n)}}{\text{PW Factor year (p)}}$$

Where:

PW Costs = Cumulative Present Worth Cost for the alternative

year (n) = year in which cross-over is desired

year (p) = year in which the project is capitalized
(i.e. 1986))

PW Factor = $(1/1.13)^2 = 0.783$ for 1986 (assuming 13% discount rate)

This gives the amount by which the project's total cost must be reduced in order for the income from the hydro plant to retire the remaining costs for the particular cross-over year.

Sensitivity cases were prepared for capital cost and discount rate increases in order to determine their impact on the viability of the project. Firm capacity of the mini hydro plant was not considered since existing firm capacity of the diesel plant is capable of meeting the projected load.

7.2 Economic Assumptions

(a) Discount Rate

The study is done in current dollars and assumes a base discount rate of 13%.

(b) Excalation

Individual escalation rates for various capital and operating costs were supplied by HYDRO'S Economic Analysis Department and are presented in Appendix E.

(c) Fuel Prices

The 1983 average price per litre for diesel fuel used was based on actual operating costs at Rigolet. Projections in Appendix D of fuel escalation were provided by HYDRO'S Economic Analysis Department.

(d) Capital Cost

A total project cost of \$2,630,000.00 was chosen as the base capital cost.

(e) Forecast Load and Generation

The load forecast used in this analysis is listed in Appendix A and the generation split between hydro and diesel is as per the regulation study.

(f) Operation and Maintenance Cost

1983 actual operating costs for the Rigolet diesel plant and an estimate of the proposed mini hydro plant operating costs were provided by Newfoundland and Labrador Hydro. These were used to estimate fixed and variable O & M for the diesel plant and hydro plant respectively. The following table lists these costs and other operating data:

O & M (1983\$)

	<u>DIESEL ALT.</u>	<u>HYDRO-DIESEL ALT.</u>
Fixed	\$101,855	\$109,555
Variable	1.35¢/kwh	1.35¢/kwh ⁽¹⁾
Lube	5.12% of fuel cost	5.12% of fuel cost
Diesel efficiency	2.70 kwh/litre	2.70 kwh/litre

Notes:

(1) Applied only to diesel generation.

These costs were escalated at the applicable rates shown in Appendix D.

No credit was given to a contribution toward operating and maintenance costs by the Municipality because of the relative insignificance of the quantity of water used by the Municipality in relation to that used by the hydro plant.

7.3 Results of Analysis

The results are presented in the graph Figure 11 and Table 7.1. Tables of detailed costs are given in Appendix E.

Considering the return on the hydro plant as supporting the entire project, there is no cross-over within the study period. Contributions in 1986 dollars, toward capital cost to achieve various cross-over dates are shown below.

TABLE 7.1
HYDRO PROJECT ANALYSIS SUMMARY (\$x 1000.)

<u>Cross Over Date</u>	<u>Cum. PW Diesel Alternative</u>	<u>Cum. PW Hydro Diesel Alternative</u>	<u>Cum. PW Difference</u>	<u>Additional Funding (1986\$)</u>
1991	1335.8	2966.4	1630.6	2082.5
1996	1999.9	3334.7	1334.8	1704.7
2001	2489.2	3611.2	1119.4	1433.0

If this is considered to be a joint project with the equivalent cost required to construct an independent water supply contributed by the Department of Municipal Affairs, the amount of external funding required is as follows:

TABLE 7.2

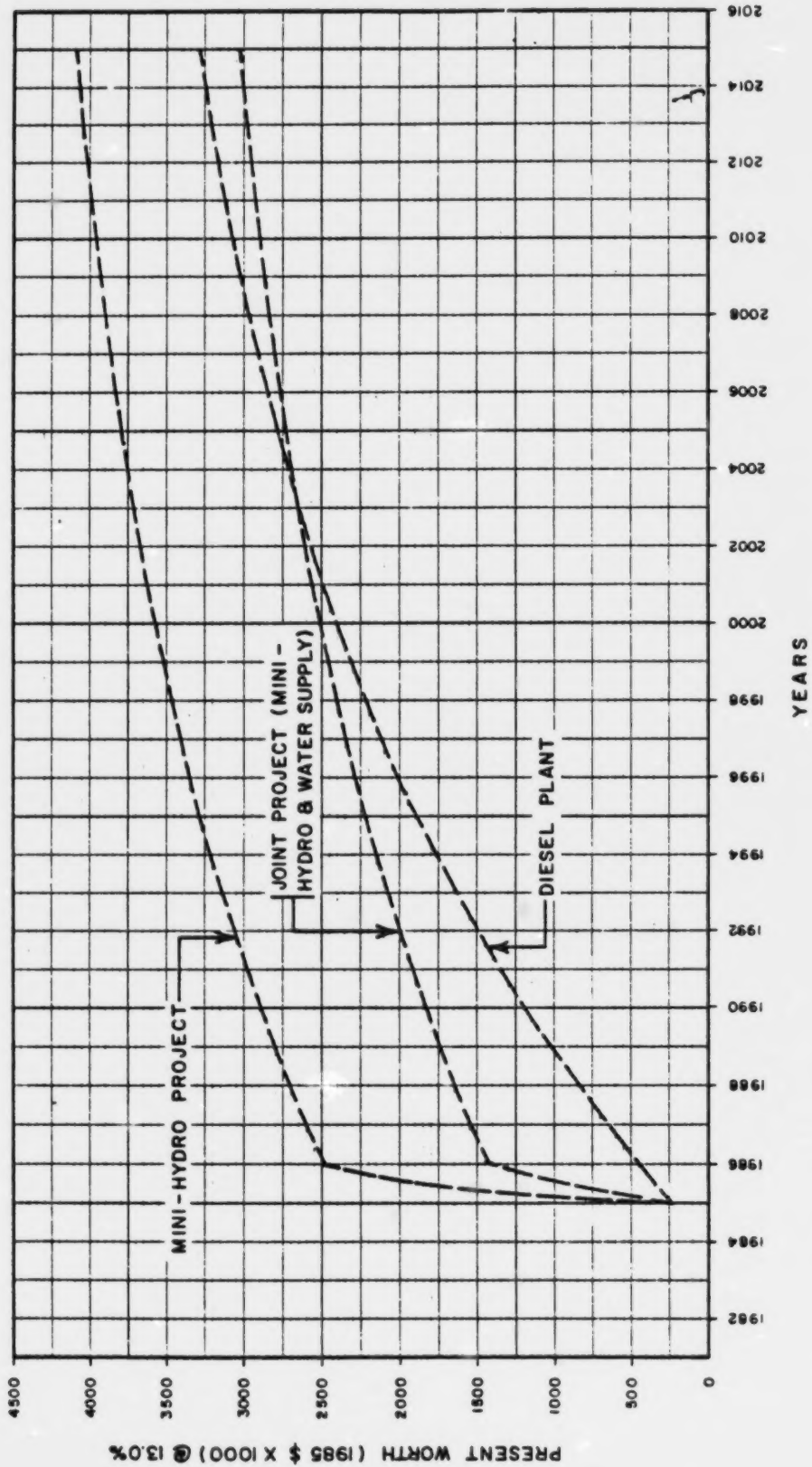
JOINT PROJECT ANALYSIS SUMMARY (X \$1000)

<u>Cross Over Date</u>	<u>Total Additional Funding (1986\$)</u>	<u>Independent Water Supply Cost (1986\$)</u>	<u>External Funding (1986\$)</u>
1991	2082.5	1350	732.5
1996	1704.7	1350	354.7
2001	1433.0	1350	83.0

The year in which the joint project would achieve a cross-over is 2003 (Figure 11).

Figure II

CUMULATIVE PRESENT WORTH
RIGOLET MINI-HYDRO VS DIESEL



7.4 Sensitivity Analysis

Since the hydro project is unfeasible on its own (i.e. there is no cross-over within the forecast period) it was not worthwhile to complete sensitivity analysis for this alternative. Sensitivities to interest rates of 12%, 14% and 15% and capital cost changes of plus and minus 10% were prepared and are shown in Figure 12 and Table 7.3 for the joint project analysis.

TABLE 7.3

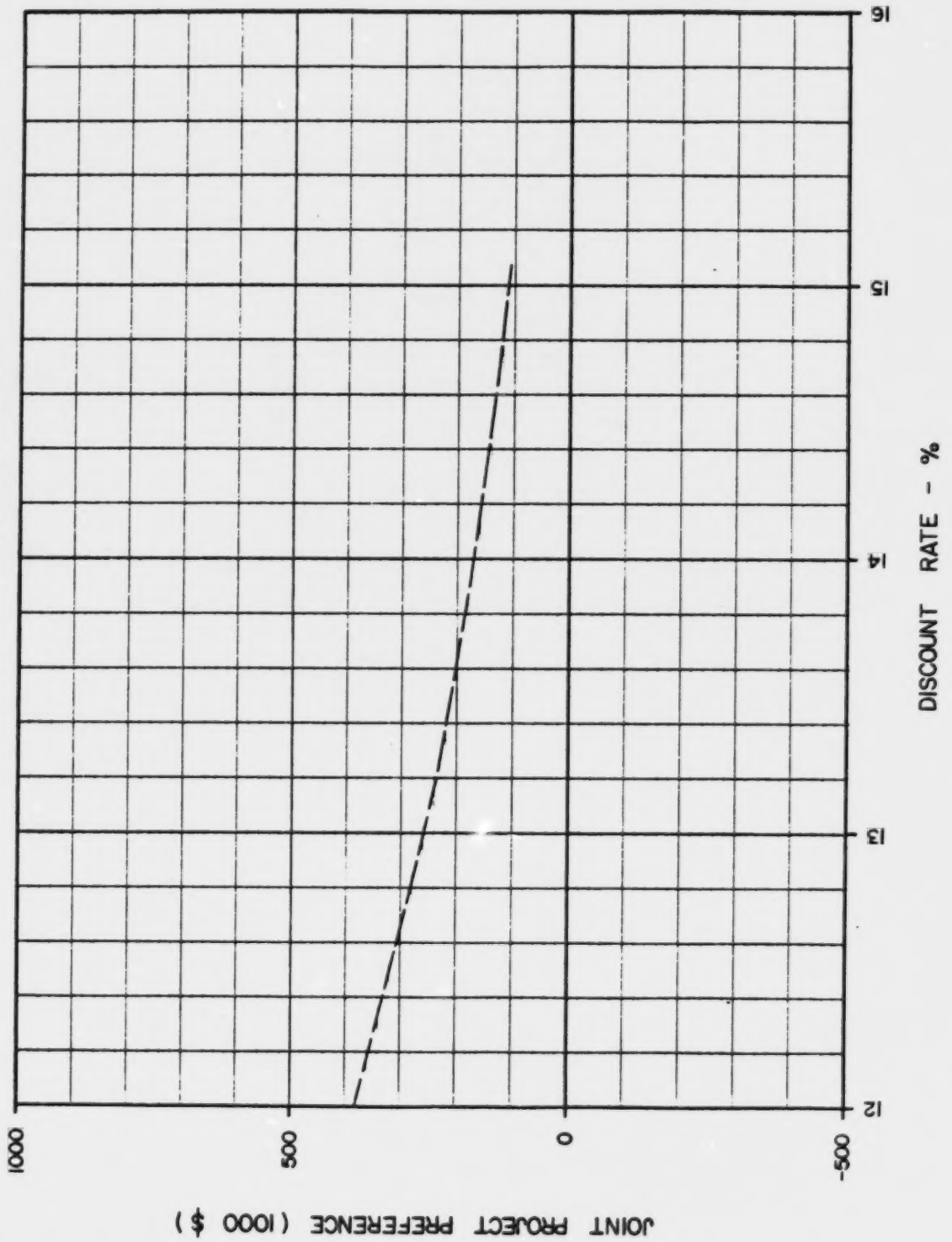
JOINT PROJECT SENSITIVITY TO CAPITAL COST INCREASE

<u>Valuation</u>	<u>Cost</u>	<u>Cross-Over Date</u>	<u>Additional Funding*</u> <u>for Cross-Over in</u>		
			<u>1991</u>	<u>1996</u>	<u>2001</u>
Est. Cost Plus 10%	3129.2	2011	992.4	612.7	342.7
Est. Cost	2866.2	2003	732.4	354.7	82.5
Est. Cost Less 10%	2603.2	1997	466.3	86.6	0

*1986\$

FIGURE 12

RIGOLET MINI-HYDRO / WATER SUPPLY PROJECT
SENSITIVITY OF DISCOUNT RATE



8.0 CONCLUSIONS AND RECOMMENDATIONS

The analysis assumes that the total benefit of fuel and lube savings would be credited toward the cost of the hydro project. It is also assumed that Newfoundland and Labrador Hydro would operate the mini hydro plant since costs attributed to the hydro plant operation and maintenance are based on using personnel already in place on an as required basis. This does not necessarily mean that Newfoundland and Labrador Hydro need own the project, however an operating agreement between Hydro and another owner would be preferable if this were not the case.

The results show that joint development of a water supply and mini hydro project at Rigolet under these conditions is cost-effective with cross-over occurring in seventeen (17) years.

The project is technically feasible and presents the opportunity to demonstrate several unique features which would provide valuable information for future development of this type.

- (1) The system is unique in that it combines pumping, siphon action and gravity flow to a turbine.
- (2) There will be no surge tank on the 2.5 km penstock.
- (3) It combines a domestic water supply for a community with a hydro project.
- (4) It demonstrates the use of hydro power to displace diesel fuel in a remote community.
- (5) The system will incorporate unique design functions in order to operate independent of weather conditions in a northern and remote location.

APPENDIX "A"
LOAD FORECAST

RIGOLET MINI-HYDRO

AVG. LOAD FORECAST

YEAR	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1986	133	105	92	78	81	74	58	71	98	97	111	122
1987	136	107	95	80	83	76	60	73	100	99	114	125
1988	140	106	97	82	85	78	61	75	103	102	117	128
1989	143	113	99	84	88	79	63	77	105	104	120	131
1990	147	115	102	86	90	81	64	79	108	107	123	134
1991	150	118	104	89	92	83	66	81	110	109	126	138
1992	154	117	107	91	94	86	67	83	113	112	129	141
1993	158	124	110	93	97	88	69	85	116	115	132	145
1994	162	127	112	95	99	90	71	87	119	118	136	149
1995	165	130	115	97	101	92	72	89	121	120	138	152
1996	168	128	117	99	103	93	74	90	124	122	141	154
1997	172	135	119	101	105	95	75	92	126	125	144	158
1998	175	138	122	103	107	97	77	94	129	127	147	161
1999	179	141	124	105	109	99	78	96	131	130	150	164
2000	183	139	127	108	112	101	80	98	134	133	153	167
2001	186	146	129	110	114	103	82	100	137	135	156	171
2002	190	149	132	112	116	105	83	102	139	138	159	174
2003	194	152	134	114	118	107	85	104	142	141	162	178
2004	197	150	137	116	121	110	86	106	145	144	165	181
2005	201	158	140	119	123	112	88	108	148	146	169	185
2006	205	162	143	121	126	114	90	110	151	149	172	188
2007	210	165	145	123	128	116	92	113	154	152	175	192
2008	214	162	148	126	131	119	94	115	157	155	179	196
2009	218	172	151	128	133	121	96	117	160	158	182	200

RIGOLET MINI-HYDRO

PEAK LOAD FORECAST

YEAR	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1986	239	207	171	159	168	151	127	166	198	185	232	244
1987	245	213	175	163	173	155	130	170	203	190	238	250
1988	251	218	179	166	177	159	133	174	207	195	243	256
1989	257	223	183	170	181	163	136	178	212	199	249	262
1990	263	228	188	174	185	166	139	182	217	204	255	268
1991	269	233	192	178	189	170	143	186	222	208	260	274
1992	275	239	197	183	194	174	146	191	228	214	267	281
1993	282	245	202	187	199	179	150	196	233	219	274	288
1994	289	251	207	192	204	183	153	201	239	224	280	295
1995	295	256	211	196	208	187	157	205	244	229	286	301
1996	300	260	214	199	211	190	159	208	248	233	291	306
1997	306	265	218	203	215	193	162	212	253	237	296	312
1998	312	270	223	207	219	197	165	216	258	242	302	318
1999	318	275	227	211	224	201	168	220	262	246	308	324
2000	324	281	232	215	228	205	172	225	268	252	314	331
2001	330	286	236	219	233	209	175	229	273	256	320	337
2002	337	292	241	224	237	213	179	234	279	261	327	344
2003	343	298	245	228	242	217	182	238	284	266	333	350
2004	350	303	250	232	246	221	186	243	289	271	339	357
2005	357	309	255	237	251	226	189	248	295	277	346	264
2006	364	315	260	241	256	230	193	252	301	282	352	371
2007	371	321	265	246	261	234	197	257	306	287	359	378
2008	378	328	270	251	266	239	201	262	313	293	367	386
2009	385	334	275	255	271	244	204	267	318	299	373	393

2010	393	341	281	261	277	249	209	273	325	305	381	401
2011	401	348	286	266	282	254	213	278	331	311	389	409
2012	409	354	292	271	288	259	217	284	338	317	396	417
2013	417	361	298	276	293	264	221	289	344	323	404	425
2014	424	368	303	281	299	268	225	294	351	329	411	433
2015	433	376	309	287	305	274	230	301	358	336	420	442
Peak Load Coeff. 0.98		0.85	0.70	.065	0.69	0.52	0.52	0.68	0.81	0.71	0.95	1.00

ENERGY AND DEMAND FORECAST

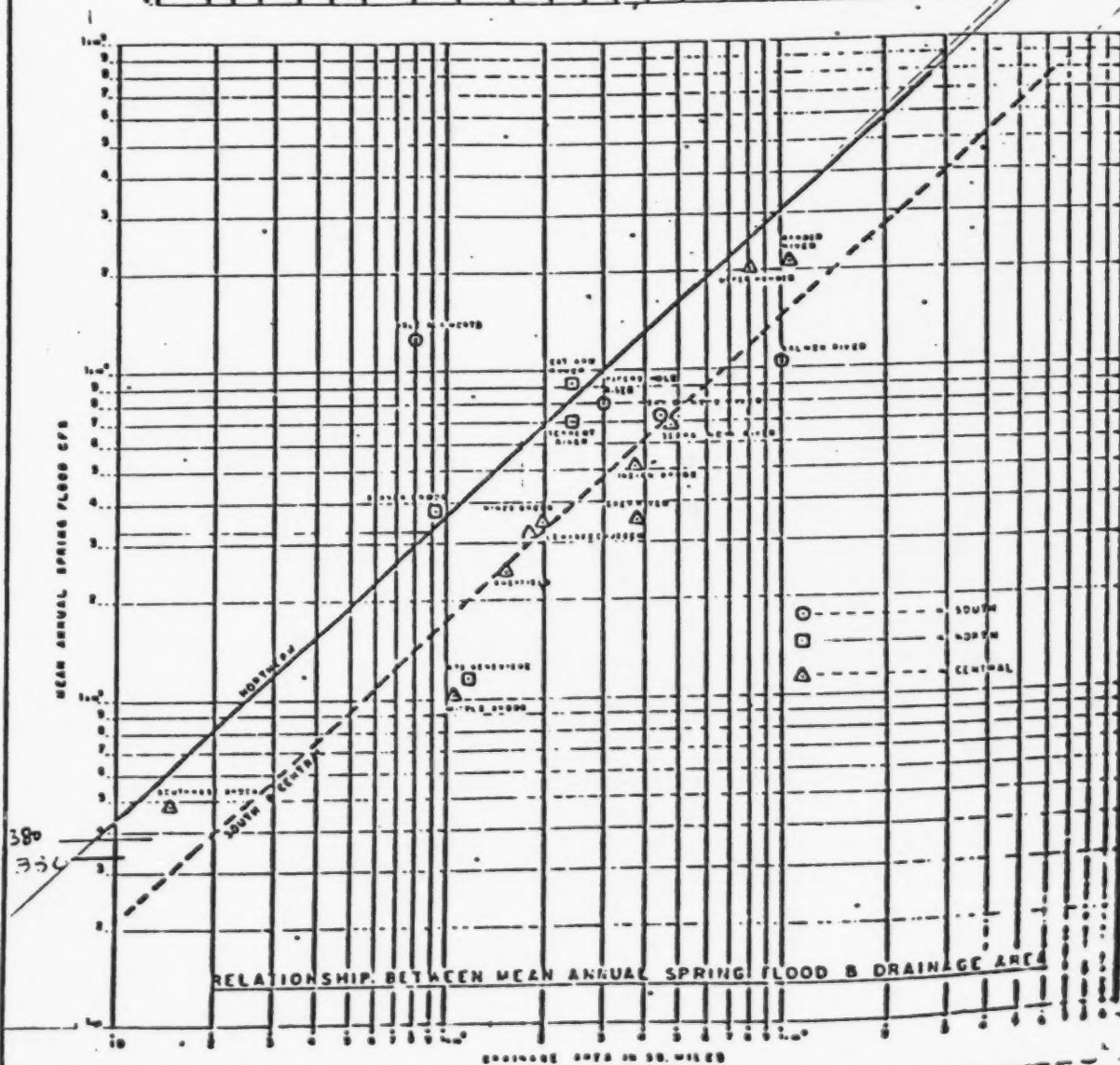
RIGOLET, LABRADOR

YEAR	% GROWTH	SALES (MWH)	NET PROD. (MWH)	STATION SERVICE MWH	GROSS PROD. (MWH)	DEMAND (KWH)
1983		692	744	37	781	223
1984	4.5	723	777		814	232
1985	2.5	741	797		834	238
1986		760	817		854	244
1987		779	838		875	250
1988		799	859		896	256
1989		818	880		917	262
1990		838	901		938	268
1991		859	924		961	274
1992		881	947		984	281
1993		903	971		1008	288
1994		926	996		1033	295
1995	2.0	945	1016		1053	301
1996		963	1035		1072	306
1997		983	1057		1094	312
1998		1002	1077		1114	318
1999		1022	1099		1136	324
2000		1043	1122		1159	331
2001		1064	1144		1181	337
2002		1085	1167		1204	344
2003		1107	1190		1227	350
2004		1129	1214		1251	357
2005		1151	1238		1275	364
2006		1174	1262		1299	371
2007		1198	1288		1325	378
2008		1222	1314		1351	386
2009		1246	1340		1377	393
2010		1271	1367		1404	401
2011		1297	1395		1432	409
2012		1323	1423		1460	417
2013		1349	1451		1488	425
2014		1376	1480		1517	433
2015		1404	1509		1546	442

Load Factor: 40%

Losses: 7%

APPENDIX "B"
HYDROLOGY STUDY



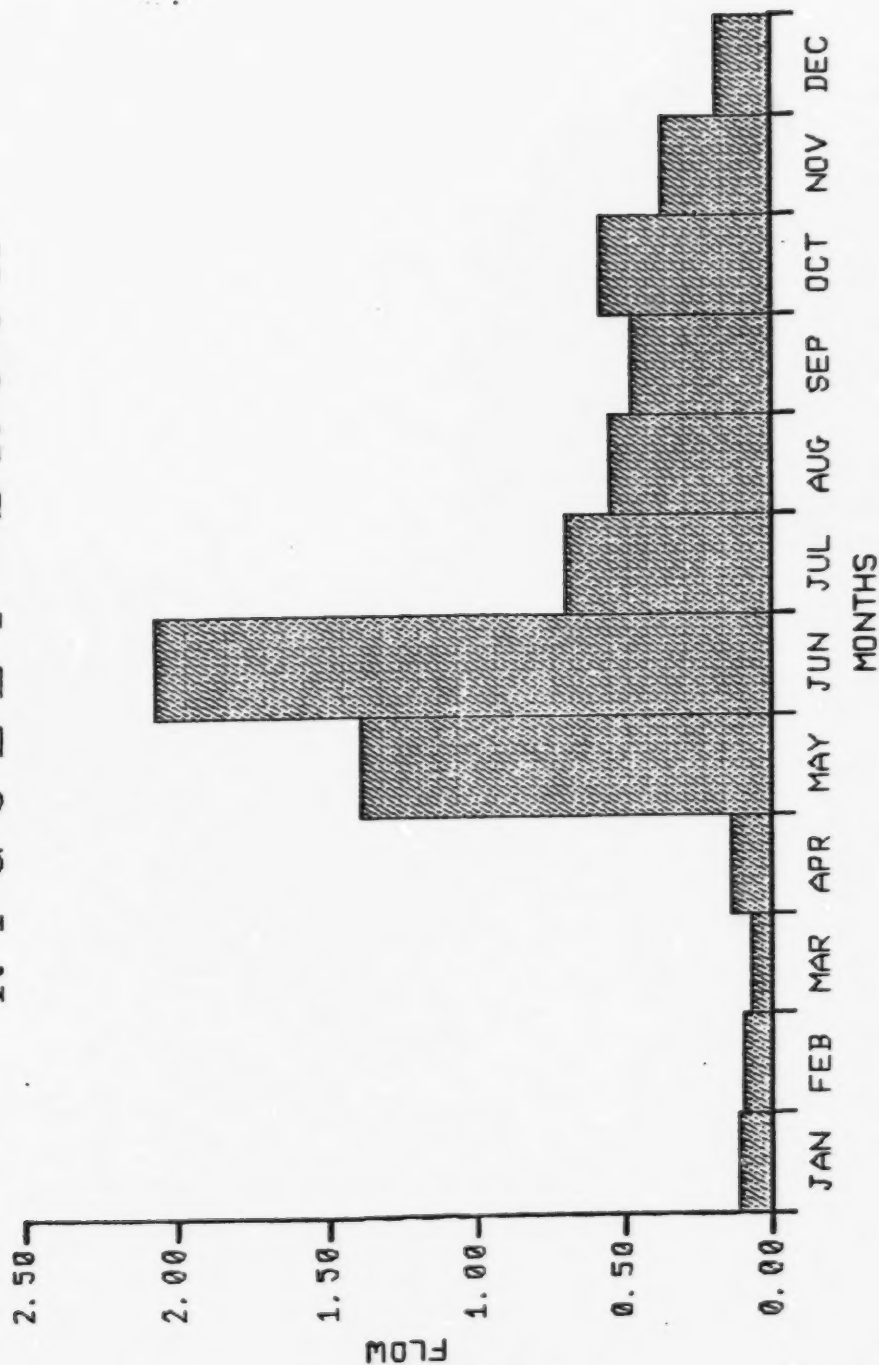
EAGLE RIVER
Monthly and Annual Mean Discharges in Cubic Metres Per Second

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Mean
1966	--	--	--	--	--	--	--	--	--	435.00	255.00	105.00	--
1967	66.40	49.30	39.70	35.70	106.00	538.00	274.00	452.00	228.00	--	--	--	--
1968	--	--	--	--	--	--	--	--	--	348.00	266.00	125.00	--
1969	98.90	86.20	78.70	74.60	494.00	1180.00	360.00	207.00	133.00	232.00	226.00	144.00	276.20
1970	87.50	63.70	52.20	48.60	702.00	648.00	327.00	300.00	134.00	175.00	124.00	74.00	228.00
1971	53.60	43.20	37.20	197.00	1400.00	909.00	263.00	187.00	283.00	288.00	135.00	83.00	323.25
1972	45.40	31.20	24.10	20.70	273.00	1310.00	224.00	242.00	294.00	261.00	101.00	50.90	239.78
1973	36.90	29.80	26.50	32.80	1140.00	585.00	270.00	148.00	94.20	100.00	107.00	61.70	219.33
1974	43.00	34.40	29.60	29.00	454.00	1470.00	375.00	213.00	109.00	220.00	95.20	36.30	259.04
1975	22.40	17.20	14.30	12.40	276.00	813.00	263.00	201.00	291.00	170.00	117.00	62.80	189.34
1976	46.30	37.70	32.60	162.00	927.00	396.00	119.00	264.00	521.00	336.00	176.00	120.00	261.47
1977	63.20	44.30	37.30	64.40	739.00	1570.00	449.00	425.00	189.00	210.00	102.00	75.00	330.68
1978	54.70	43.80	35.90	47.20	517.00	1550.00	386.00	169.00	242.00	515.00	175.00	92.90	319.04
1979	68.10	69.10	69.00	--	--	337.00	288.00	333.00	292.00	290.00	194.00	67.00	--
1980	44.10	34.40	29.30	--	--	1010.00	533.00	339.00	187.00	333.00	352.00	143.00	--
1981	89.00	68.00	57.10	76.80	1260.00	1090.00	400.00	271.00	158.00	398.00	255.00	91.10	351.17
1982	57.70	43.80	35.70	34.70	324.00	1390.00	502.00	203.00	258.00	129.00	155.00	108.00	270.08
Mean	58.48	46.41	39.95	64.30	662.46	986.40	335.53	263.60	227.55	277.50	177.20	89.98	269.11

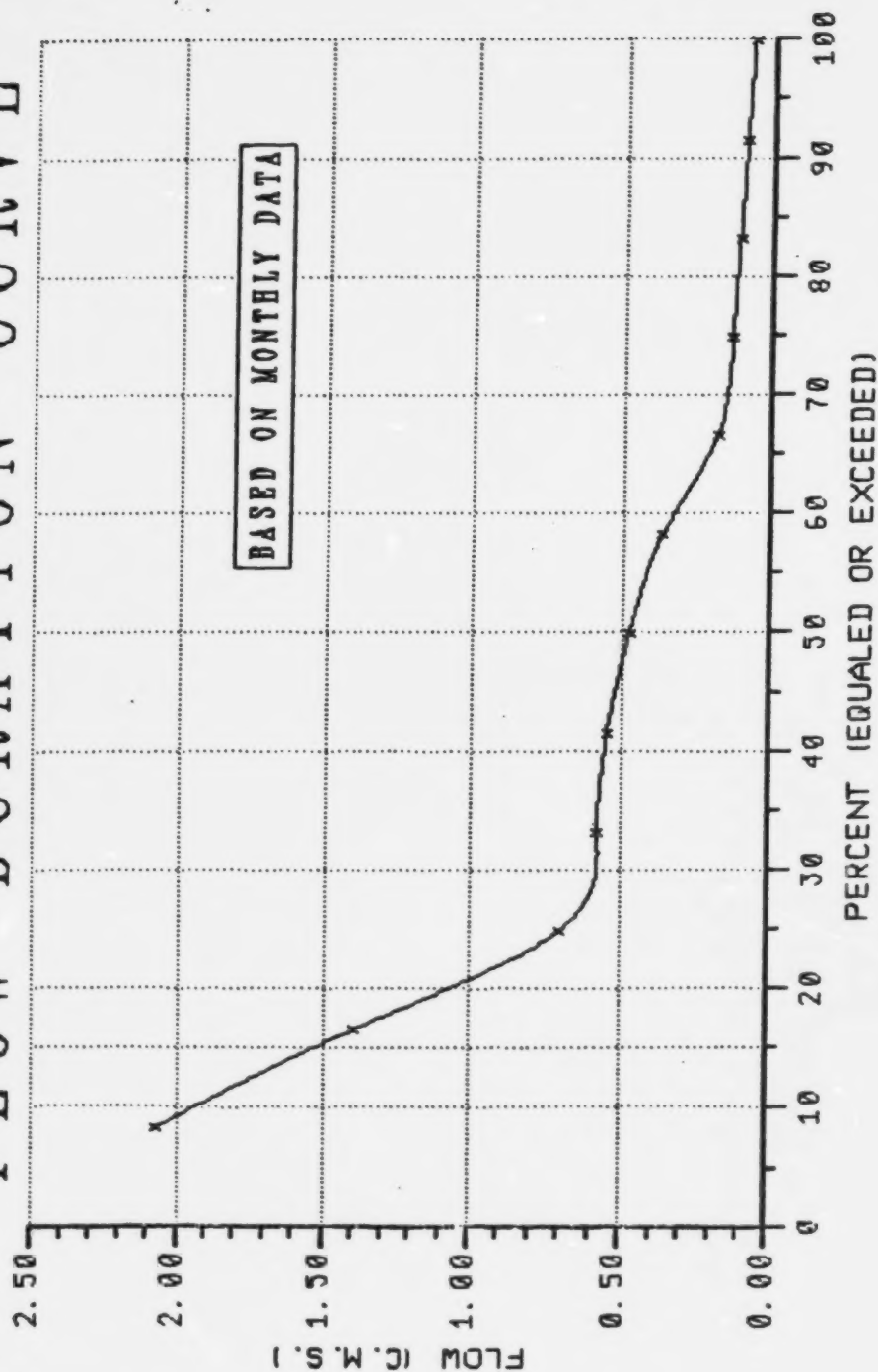
RIGOLET BROOK
Synthesised Monthly and Annual Mean Discharges in Cubic Metres Per Second
Drainage Area Ratio = 0.00210

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Mean
1966	--	--	--	--	--	--	--	--	--	0.91	0.54	0.22	--
1967	0.14	0.10	0.08	0.07	0.22	1.13	0.58	0.95	0.48	--	--	--	--
1968	--	--	--	--	--	--	--	--	--	0.73	0.56	0.26	--
1969	0.21	0.18	0.17	0.16	1.04	2.48	0.76	0.43	0.28	0.49	0.47	0.30	0.58
1970	0.18	0.13	0.11	0.10	1.47	1.36	0.69	0.63	0.28	0.37	0.26	0.16	0.48
1971	0.11	0.09	0.08	0.41	2.94	1.91	0.55	0.39	0.59	0.60	0.28	0.17	0.68
1972	0.10	0.07	0.05	0.04	0.57	2.75	0.47	0.51	0.62	0.55	0.21	0.11	0.50
1973	0.08	0.06	0.06	0.07	2.39	1.23	0.57	0.31	0.20	0.21	0.22	0.13	0.46
1974	0.09	0.07	0.06	0.06	0.95	3.09	0.79	0.45	0.23	0.46	0.20	0.08	0.54
1975	0.05	0.04	0.03	0.03	0.58	1.71	0.55	0.42	0.61	0.36	0.25	0.13	0.40
1976	0.10	0.08	0.07	0.34	1.95	0.83	0.25	0.55	1.09	0.71	0.37	0.25	0.55
1977	0.13	0.09	0.08	0.14	1.55	3.30	0.94	0.89	0.40	0.44	0.21	0.16	0.69
1978	0.11	0.09	0.08	0.10	1.09	3.26	0.81	0.35	0.51	1.08	0.37	0.20	0.67
1979	0.14	0.15	0.14	--	--	0.71	0.60	0.70	0.61	0.61	0.41	0.14	--
1980	0.09	0.07	0.06	--	--	2.12	1.12	0.71	0.39	0.70	0.74	0.30	--
1981	0.19	0.14	0.12	0.16	2.65	2.29	0.84	0.57	0.33	0.84	0.54	0.19	0.74
1982	0.12	0.09	0.07	0.07	0.68	2.92	1.05	0.43	0.54	0.27	0.33	0.23	0.57
Mean	0.12	0.10	0.09	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	0.57

MEAN FLOWS RIGOLET BROOK

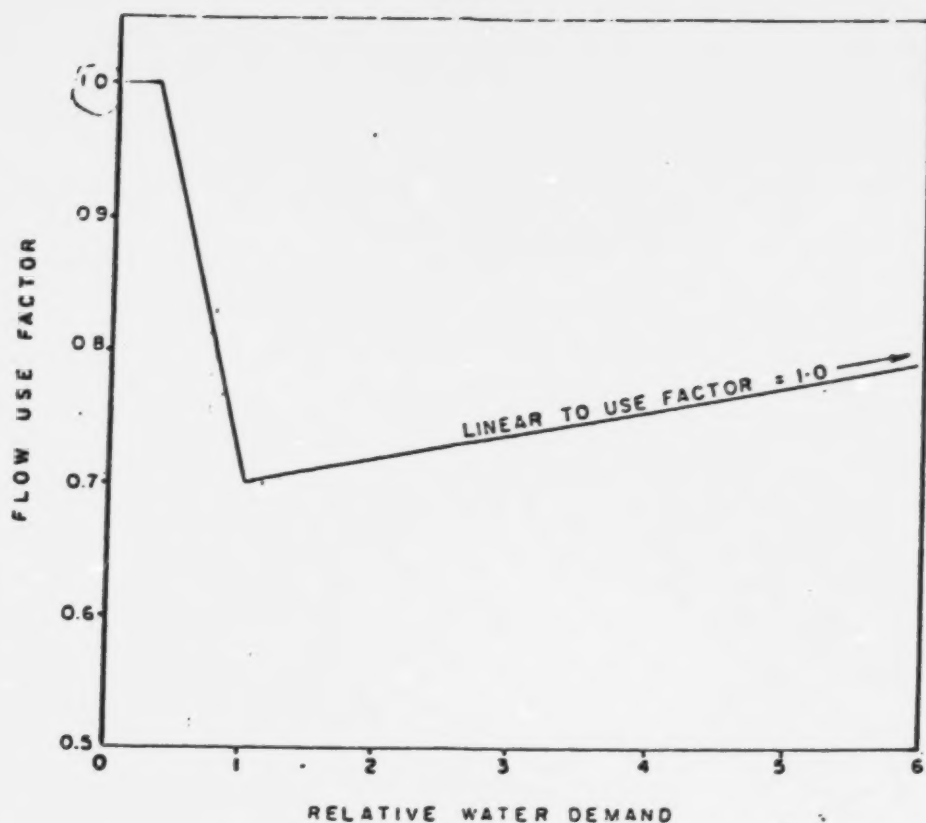


RIGOLET BROOK FLOW DURATION CURVE



APPENDIX "C"
REGULATION STUDY

FIGURE 4-2



NOTES:

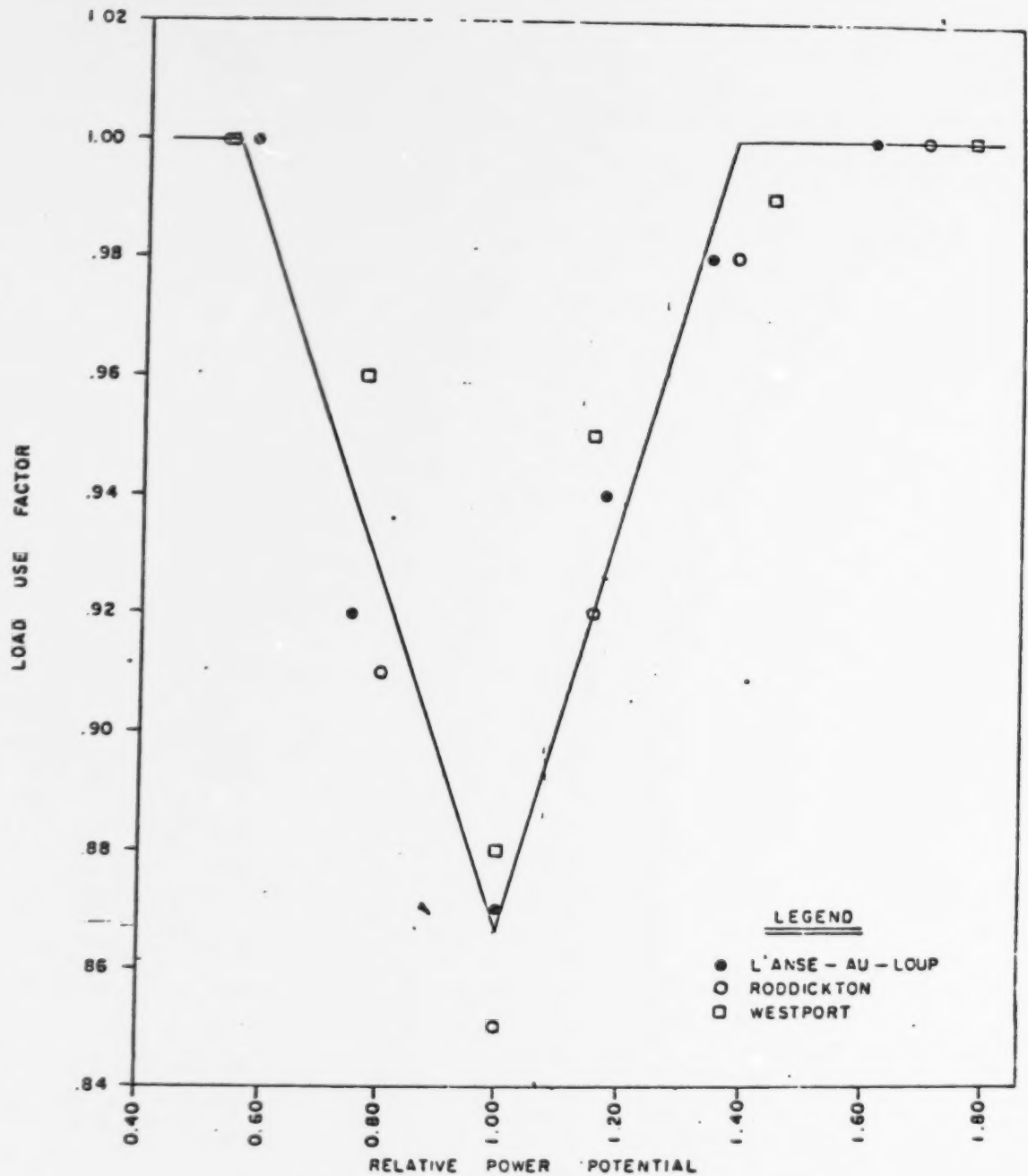
- 1) FLOW USE FACTOR = $\frac{\text{ENERGY GENERATED (ACTUAL FLOW, CONSTANT LOAD)}}{\text{ENERGY GENERATED (CONSTANT FLOW, CONSTANT LOAD)}}$
- 2) RELATIVE WATER DEMAND = $\frac{\text{WATER REQUIRED}}{\text{WATER AVAILABLE}}$

NEWFOUNDLAND & LABRADOR HYDRO
SMALL SCALE HYDRO STUDY
SHAWMONT NEWFOUNDLAND LIMITED

FLOW USE CURVE

	DESIGN RJK	SCALE	DATE MAR, 1979
CONTRACT 479	PROJECT	LOCATION	DRAWING

FIGURE 4-5



NOTES:

1) RELATIVE POWER POTENTIAL = $\frac{\text{PLANT CAPABILITY}}{\text{AVERAGE LOAD}}$

2) LOAD USE FACTOR =

$\frac{\text{ENERGY GENERATED (ACTUAL LOAD, CONSTANT FLOW)}}{\text{ENERGY GENERATED (CONSTANT LOAD, CONSTANT FLOW)}}$

NEWFOUNDLAND & LABRADOR HYDRO
SMALL SCALE HYDRO STUDY
SHAWMONT NEWFOUNDLAND LIMITED

LOAD USE CURVE

DESIGNED BY T.M. THORVE	SCALE	DATE JUN 79
CONTRACT 479	FILE NO.	APPROVED

RIGOLET MINI-HYDRO

SUMMARY POWER AND ENERGY STUDY

(1) Year	(2) Forecast Energy (MWH)	(125 KW UNIT)				
		(3) Pump Energy Required (MWH)	(4) Total Energy Required (MWH)	(5) Total Hydro Energy (MWH)	(6) Net Hydro Energy (MWH)	(7) Total Diesel Energy (MWH)
			(2 + 3)		(5 - 3)	(4 - 5)
1986	817	28	845	708	680	137
1987	838	28	866	716	688	150
1988	859	28	887	723	695	164
1989	880	28	908	729	701	179
1990	901	28	929	736	708	193
1991	924	28	952	745	717	207
1992	947	28	975	753	725	222
1993	971	28	999	762	734	237
1994	996	28	1 024	767	739	257
1995	1 016	28	1 044	770	742	270
1996	1 035	28	1 063	773	745	290
1997	1 057	28	1 085	777	749	308
1998	1 077	28	1 105	780	752	325
1999	1 099	28	1 127	784	756	343
2000	1 122	28	1 150	789	761	361
2001	1 144	28	1 172	793	765	379
2002	1 167	28	1 195	797	769	398
2003	1 190	28	1 218	800	772	418
2004	1 214	28	1 242	805	777	437
2005	1 238	28	1 266	809	781	457
2006	1 262	28	1 290	813	785	477
2007	1 288	28	1 316	818	790	498
2008	1 314	28	1 342	820	792	522
2009	1 340	28	1 368	822	794	546
2010	1 367	28	1 395	822	794	573
2011	1 395	28	1 423	823	795	600
2012	1 423	28	1 451	824	796	627
2013	1 451	28	1 479	825	797	654
2014	1 480	28	1 508	826	798	682
2015	1 510	28	1 538	828	800	710

[illegible]

[illegible]

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1988	31	29	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	250.88	217.60	179.20	166.40	176.64	158.72	133.12	174.08	207.36	194.56	243.20	256.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	859	859	859	859	859	859	859	859	859	859	859	359	
10. Net Produc. MMH	103.94	73.87	72.16	59.27	63.57	55.84	45.53	55.84	73.37	75.59	84.18	95.35	
11. Avg. Load KW	139.70	106.14	96.98	82.32	85.44	77.55	61.19	75.05	102.60	101.60	116.92	128.16	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.59	0.78	0.86	1.01	1.22	1.34	1.70	1.39	1.01	1.02	0.39	0.65	
14. Load Use Factor	0.98	0.93	0.91	0.87	0.94	0.99	1.00	1.00	0.87	0.88	0.90	0.97	
15. Power Main Demand KW	137.49	98.69	88.10	71.64	80.57	76.49	61.19	75.05	89.45	88.93	105.10	124.14	1,097
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	140.49	106.29	100.10	87.64	80.57	76.49	61.19	75.05	89.45	88.93	105.10	124.14	1,135
19. Hydro Energy Prod. MMH	61.83	57.84	61.83	59.33	77.38	74.38	77.38	77.38	74.38	77.38	74.38	61.33	337
20. Total Energy Req'd MMH	104.52	73.97	74.47	63.10	59.95	55.07	45.53	55.34	64.40	66.16	75.68	92.36	331
21. Diesel Energy Req'd MMH	42.70	16.14	12.65	3.27	0	0	0	0	0	0	0.30	30.53	106

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1989	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load MW	256.76	222.70	183.40	170.30	180.78	162.44	136.24	178.16	212.22	199.12	248.90	262.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	880	880	880	880	980	880	880	880	880	980	880	980	
10. Net Produc. MMH	106.48	75.68	73.92	60.72	65.12	57.20	46.64	57.20	75.68	77.44	86.24	97.68	
11. Avg. Load KW	143.12	112.62	99.35	84.33	87.53	79.44	62.69	76.88	105.11	104.09	119.78	131.29	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.58	0.74	0.84	0.99	1.19	1.31	1.66	1.35	0.99	1.00	0.87	0.63	
14. Load Use Factor	0.99	0.94	0.91	0.87	0.93	0.98	1.00	0.99	0.87	0.97	0.91	0.97	
15. Power Main Demand KW	141.44	106.18	90.84	73.47	81.65	77.47	62.69	76.15	91.45	90.27	108.41	127.76	1,128
16. Hydro Power Gen. KW	93.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	144.44	113.78	102.84	89.47	81.65	77.47	62.69	76.15	91.45	90.27	109.41	127.76	1,166
19. Hydro Engery Prod. MMH	61.83	55.84	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.88	61.83	635
20. Total Energy Req'd MMH	107.46	76.46	76.51	64.42	60.75	55.78	46.64	56.65	65.55	67.16	78.15	95.05	851
21. Diesel Energy Req'd MMH	45.63	20.61	14.69	4.59	0	0	0	0	0	0	3.17	33.23	122

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1990	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	262.64	227.80	187.60	174.26	184.92	166.16	139.36	182.24	217.08	203.68	254.60	268.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	901	901	901	901	901	901	901	901	901	901	901	901	
10. Net Produc. MMH	109.02	77.49	75.68	62.17	66.67	58.57	47.75	58.57	77.49	79.29	88.30	100.01	
11. Avg. Load KW	146.53	115.31	101.73	86.35	89.62	81.34	64.18	78.72	107.62	106.57	122.64	134.42	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.57	0.72	0.82	0.96	1.16	1.28	1.62	1.32	0.97	0.98	0.85	0.62	
14. Load Use Factor	0.99	0.95	0.92	0.88	0.92	0.96	1.00	0.98	0.98	0.87	0.91	0.98	
15. Power Main Demand KW	145.39	109.28	93.58	75.80	82.73	78.45	64.18	77.10	94.35	93.14	111.71	131.38	1.157
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1.144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	148.39	116.88	105.58	91.80	82.73	78.45	64.18	77.10	94.35	93.14	111.71	131.38	1.196
19. Hydro Energy Prod. MMH	61.82	55.34	61.83	59.93	77.38	74.38	77.38	77.38	74.38	77.38	74.38	61.83	825
20. Total Energy Req'd MMH	110.40	79.55	79.55	66.10	61.55	56.49	47.75	57.36	67.73	69.30	80.43	97.75	972
21. Diesel Energy Req'd MMH	48.57	22.70	16.73	6.26	0	0	0	0	0	0	5.55	25.92	136

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1991	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	268.52	232.90	191.80	178.10	189.06	169.88	142.48	186.32	221.94	208.24	260.30	274.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	924	924	924	924	924	924	924	924	924	924	924	924	
10. Net Produc. MMH	111.80	79.46	77.62	63.76	68.38	60.06	48.97	60.06	79.46	81.31	90.55	102.56	
11. Avg. Load KW	150.27	118.25	104.32	88.55	91.90	83.42	65.82	80.73	110.37	109.29	125.77	137.85	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.55	0.70	0.80	0.94	1.13	1.25	1.58	1.29	0.94	0.95	0.83	0.60	
14. Load Use Factor	1.00	0.95	0.93	0.88	0.91	0.95	1.00	0.97	0.88	0.98	0.92	0.98	
15. Power Main Demand KW	149.71	112.69	96.58	78.35	83.91	79.53	65.82	78.14	97.53	96.28	115.33	135.35	1,169
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	152.71	120.29	108.58	94.35	83.91	79.53	65.82	78.14	97.53	96.28	115.33	135.35	1,228
19. Hydro Energy Prod. MMH	61.33	55.84	61.33	59.83	77.38	74.98	77.38	77.38	74.88	77.38	74.98	61.33	835
20. Total Energy Req'd MMH	113.62	80.83	90.79	67.93	62.43	57.26	48.97	58.13	70.22	71.64	83.04	100.70	896
21. Diesel Energy Req'd MMH	51.79	24.99	19.96	8.10	0	0	0	0	0	0	9.16	38.88	151

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1992	31	29	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	275.38	238.85	196.70	182.65	193.89	174.22	146.12	191.08	227.61	213.56	266.95	281.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MWH	947	947	947	947	947	947	947	947	947	947	947	947	
10. Net Produc. MWH	114.59	81.44	79.55	65.34	70.08	61.56	50.19	61.56	81.44	83.34	92.81	105.12	
11. Avg. Load KW	154.01	117.01	106.92	90.75	94.19	85.49	67.46	82.74	113.11	112.01	128.90	141.29	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.54	0.71	0.78	0.92	1.10	1.22	1.54	1.26	0.92	0.93	0.91	0.59	
14. Load Use Factor	1.00	0.95	0.93	0.89	0.90	0.94	1.00	0.96	0.89	0.89	0.92	0.99	
15. Power Main Demand KW	154.01	111.26	99.59	80.90	85.10	80.60	67.46	79.17	100.70	99.43	118.95	139.32	1,216
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	157.01	118.86	111.59	96.90	85.10	80.60	67.46	79.17	100.70	99.43	118.95	139.32	1,253
19. Hydro Engery Prod. MWH	61.83	57.84	61.83	59.33	77.38	74.38	77.38	77.38	74.38	77.38	74.38	61.83	837
20. Total Energy Req'd MWH	116.82	82.72	83.02	69.77	63.21	58.03	50.19	58.91	72.51	73.98	85.65	103.65	919
21. Diesel Energy Req'd MWH	54.99	24.89	21.19	9.93	0	0	0	0	0	0	10.77	41.83	164

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1993	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	282.24	244.80	201.60	187.20	198.72	178.56	149.76	195.84	233.28	218.88	273.60	288.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MJH	971	971	971	971	971	971	971	971	971	971	971	971	
10. Net Produc. MJH	117.49	83.51	81.56	67.00	71.85	63.12	51.46	63.12	83.51	85.45	95.16	107.78	
11. Avg. Load KW	157.92	124.26	109.63	93.05	96.58	87.66	69.17	84.83	115.98	114.85	132.16	144.87	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.53	0.67	0.76	0.89	1.08	1.19	1.50	1.23	0.90	0.91	0.79	0.57	
14. Load Use Factor	1.00	0.96	0.94	0.90	0.89	0.93	1.00	0.95	0.90	0.89	0.93	0.99	
15. Power Main Demand KW	157.92	119.64	102.72	83.56	86.33	81.72	69.17	80.26	104.02	102.71	122.73	143.46	1,254
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	160.92	127.24	114.72	99.56	86.33	81.72	69.17	80.26	104.02	102.71	122.73	143.46	1,293
19. Hydro Engery Prod. MJH	61.83	55.84	61.83	59.83	77.38	74.88	77.38	77.38	74.83	77.38	74.38	61.83	835
20. Total Energy Req'd MJH	119.72	85.51	85.35	71.68	64.23	58.84	51.46	59.71	74.89	76.42	88.36	106.73	943
21. Diesel Energy Req'd MJH	57.90	29.66	23.52	11.85	0	0	0	0	0.01	0	13.48	44.91	181

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1994	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.31	0.76	0.95	1.00	
6. Peak Load KW	289.10	250.75	206.50	191.75	203.55	182.90	153.40	200.60	238.95	224.20	280.25	295.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	996	996	996	996	996	996	996	996	996	996	996	996	
10. Net Produc. MMH	120.52	85.66	83.66	68.72	73.70	64.74	52.79	64.74	85.66	87.65	97.61	110.56	
11. Avg. Load KW	161.98	127.46	112.45	95.45	99.06	89.92	70.95	87.02	118.97	117.81	135.57	148.60	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.51	0.65	0.74	0.97	1.05	1.16	1.47	1.20	0.87	0.88	0.77	0.56	
14. Load Use Factor	1.00	0.97	0.94	0.90	0.88	0.92	1.00	0.94	0.90	0.90	0.93	0.99	
15. Power Main Demand KW	161.98	123.34	105.98	86.33	97.62	82.89	70.95	81.39	107.47	106.13	126.66	147.77	1,259
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	164.98	130.94	117.98	102.33	97.62	82.89	70.95	81.39	107.47	106.13	126.66	147.77	1,327
19. Hydro Energy Prod. MMH	61.83	55.84	61.33	59.83	77.38	74.38	77.38	77.38	74.38	77.38	74.38	61.83	835
20. Total Energy Req'd MMH	122.75	97.99	87.78	73.67	65.19	59.68	52.79	60.55	77.38	78.96	91.20	109.94	968
21. Diesel Energy Req'd MMH	60.92	32.15	25.95	13.84	0	0	0	0	2.50	1.58	16.32	48.11	201

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1995	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.75	1.00	
6. Peak Load KW	294.98	255.85	210.70	195.65	207.69	186.62	156.52	204.68	243.81	228.76	285.95	301.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	
10. Net Produc. MMH	122.94	87.38	85.34	70.10	75.18	66.04	53.85	66.04	87.38	39.41	99.57	112.78	
11. Avg. Load KW	165.24	130.02	114.71	97.37	101.05	91.72	72.38	98.76	121.36	120.17	138.29	151.58	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.50	0.64	0.72	0.85	1.03	1.13	1.44	1.17	0.86	0.87	0.75	0.55	
14. Load Use Factor	1.00	0.97	0.95	0.91	0.88	0.91	1.00	0.93	0.91	0.91	0.94	1.00	
15. Power Main Demand KW	165.24	126.30	108.59	88.54	88.64	83.82	72.38	82.29	110.23	108.86	129.81	151.22	1,316
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	168.24	133.90	120.59	104.54	88.64	83.82	72.38	82.29	110.23	108.86	129.81	151.22	1,355
19. Hydro Energy Prod. MMH	61.83	55.84	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.88	61.83	835
20. Total Energy Req'd MMH	125.17	89.98	89.72	75.27	65.95	60.35	53.85	61.22	79.37	61.00	93.46	112.51	988
21. Diesel Energy Req'd MMH	63.34	34.14	27.89	15.44	0	0	0	0	4.49	3.62	18.59	50.68	218

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1996	31	29	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	299.88	260.10	214.20	198.90	211.14	189.72	159.12	208.08	247.86	232.56	290.70	306.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1035	1035	1035	1035	1035	1035	1035	1035	1035	1035	1035	1035	
10. Net Produc. MMH	125.24	89.01	86.94	71.42	76.59	67.28	54.86	67.28	89.01	91.08	101.43	114.89	
11. Avg. Load KW	168.33	127.89	116.85	99.19	102.94	93.44	73.73	90.42	123.63	122.42	140.88	154.42	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.49	0.65	0.71	0.84	1.01	1.11	1.41	1.15	0.84	0.85	0.74	0.54	
14. Load Use Factor	1.00	0.97	0.95	0.91	0.87	0.91	1.00	0.92	0.91	0.91	0.94	1.00	
15. Power Main Demand KW	168.33	123.83	111.07	90.65	89.62	84.71	73.73	83.15	112.86	111.46	132.80	154.42	1,337
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	93.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	171.33	131.43	123.07	106.65	89.62	84.71	73.73	83.15	112.86	111.46	132.80	154.42	1,375
19. Hydro Energy Prod. MMH	61.83	57.84	61.83	59.83	77.38	74.88	77.38	77.38	74.38	77.38	74.58	61.83	937
20. Total Energy Req'd MMH	127.47	91.47	91.57	76.79	66.68	60.99	54.86	61.36	81.26	82.93	95.62	114.89	1,006
21. Diesel Energy Req'd MMH	65.64	33.64	29.74	16.95	0	0	0	0	6.38	5.55	20.74	53.06	232

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1997	31	'28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	305.76	265.20	218.40	202.80	215.28	193.44	162.24	212.16	252.72	237.12	296.40	312.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057	
10. Net Produc. MMH	127.90	90.90	88.79	72.93	78.22	68.71	56.02	68.71	90.90	93.02	103.59	117.33	
11. Avg. Load KW	171.90	135.27	119.34	101.30	105.13	95.42	75.30	92.35	126.25	125.02	143.87	157.70	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.48	0.61	0.70	0.82	0.99	1.09	1.38	1.13	0.82	0.83	0.72	0.53	
14. Load Use Factor	1.00	0.98	0.95	0.92	0.87	0.90	1.00	0.91	0.92	0.92	0.95	1.00	
15. Power Main Demand KW	171.90	132.36	113.94	93.08	91.48	85.73	75.30	84.14	115.90	114.47	136.26	157.70	1,372
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	174.90	139.96	125.94	109.08	91.48	85.73	75.30	84.14	115.90	114.47	136.26	157.70	1,411
19. Hydro Engery Prod. MMH	61.83	55.84	61.83	59.93	77.38	74.89	77.38	77.38	74.88	77.38	74.88	61.83	935
20. Total Energy Req'd MMH	130.13	94.06	93.70	78.34	68.06	61.73	56.02	62.60	83.44	85.17	98.11	117.33	1,029
21. Diesel Energy Req'd MMH	68.30	38.21	31.88	18.71	0	0	0	0	8.56	7.79	23.23	55.50	252

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1998	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	311.64	270.30	222.60	206.70	219.42	197.16	165.36	216.24	257.58	241.68	302.10	318.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1077	1077	1077	1077	1077	1077	1077	1077	1077	1077	1077	1077	
10. Net Produc. MMH	130.32	92.62	90.47	74.31	79.70	70.01	57.08	70.01	92.62	94.78	105.55	119.55	
11. Avg. Load KW	175.16	137.83	121.60	103.21	107.12	97.23	76.72	94.09	128.64	127.39	146.59	160.68	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.47	0.60	0.68	0.81	0.97	1.07	1.36	1.11	0.81	0.82	0.71	0.52	
14. Load Use Factor	1.00	0.98	0.96	0.92	0.98	0.89	0.99	0.90	0.92	0.92	0.95	1.00	
15. Power Main Demand KW	175.16	135.32	116.55	95.30	93.78	86.67	76.07	85.05	118.66	117.21	139.41	160.68	1,400
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	178.16	142.92	128.55	111.30	93.78	86.67	76.07	85.05	118.66	117.21	139.41	160.68	1,438
19. Hydro Engery Prod. MMH	61.83	55.84	61.83	59.93	77.38	74.88	77.38	77.38	74.38	77.38	74.38	61.83	935
20. Total Energy Req'd MMH	132.55	96.04	95.64	80.14	69.77	62.40	56.59	63.27	85.43	87.20	100.37	119.55	1,149
21. Diesel Energy Req'd MMH	70.72	40.20	33.82	20.30	0	0	0	0	10.55	9.93	25.49	57.72	269

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 1999	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	317.52	275.40	226.80	210.60	223.56	200.88	168.48	220.32	262.44	246.24	307.80	324.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MWH	1099	1099	1099	1099	1099	1099	1099	1099	1099	1099	1099	1099	
10. Net Produc. MWH	132.98	94.51	92.32	75.83	81.33	71.44	58.25	71.44	94.51	96.71	107.70	121.99	
11. Avg. Load KW	178.74	140.65	124.08	105.32	109.31	99.22	78.29	96.01	131.27	129.99	149.59	163.96	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.46	0.59	0.67	0.79	0.95	1.05	1.33	1.08	0.79	0.90	0.70	0.51	
14. Load Use Factor	1.00	0.99	0.96	0.93	0.88	0.88	0.98	0.90	0.93	0.92	0.96	1.00	
15. Power Main Demand KW	178.74	138.58	119.43	97.74	96.31	87.69	76.88	86.04	121.70	120.21	142.87	163.96	1,430
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	181.74	146.18	131.43	113.74	96.31	87.69	76.88	86.04	121.70	120.21	142.87	163.96	1,469
19. Hydro Engery Prod. MWH	61.93	55.84	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.88	61.83	825
20. Total Energy Req'd MWH	135.21	98.23	97.78	81.69	71.65	63.14	57.20	64.01	87.62	89.44	102.97	121.99	1,071
21. Diesel Energy Req'd MWH	73.38	42.39	35.96	22.06	0	0	0	0	12.74	12.06	27.99	60.16	287

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2000	31	29	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	324.38	281.35	231.70	215.15	228.39	205.22	172.12	225.08	268.11	251.56	314.45	331.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1122	1122	1122	1122	1122	1122	1122	1122	1122	1122	1122	1122	
10. Net Produc. MMH	135.76	96.49	94.25	77.42	83.83	72.93	59.47	72.93	96.49	98.74	109.96	124.54	
11. Avg. Load KW	182.48	138.64	126.68	107.53	111.60	101.29	79.93	98.02	134.02	132.71	152.72	167.40	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.46	0.60	0.66	0.77	0.93	1.03	1.30	1.06	0.78	0.78	0.68	0.50	
14. Load Use Factor	1.00	0.98	0.97	0.93	0.89	0.98	0.97	0.89	0.93	0.93	0.96	1.00	
15. Power Main Demand KW	182.48	136.26	122.43	100.29	98.95	88.77	77.72	87.08	124.87	123.36	146.49	167.40	1,456
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	185.48	143.86	134.43	116.29	98.95	88.77	77.72	97.08	124.87	123.36	146.49	167.40	1,495
19. Hydro Engery Prod. MMH	61.83	57.84	61.83	59.83	77.38	74.88	77.38	77.38	74.86	77.38	74.88	61.83	827
20. Total Energy Req'd MMH	137.99	100.12	100.02	83.73	73.62	63.91	57.83	64.79	39.91	91.79	105.47	124.54	1,094
21. Diesel Energy Req'd MMH	76.17	42.29	38.19	23.89	0	0	0	0	15.03	14.40	30.59	62.72	303

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2001	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	330.26	286.45	235.90	219.05	232.53	208.94	175.24	229.16	272.97	256.12	320.15	337.80	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MWH	1144	1144	1144	1144	1144	1144	1144	1144	1144	1144	1144	1144	
10. Net Produc. MWH	138.42	98.38	96.10	78.94	84.66	74.36	60.63	74.36	98.38	100.67	112.11	126.98	
11. Avg. Load KW	186.05	146.40	129.16	109.63	113.78	103.28	81.49	99.95	136.64	135.31	155.71	170.68	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.45	0.57	0.64	0.76	0.91	1.01	1.28	1.04	0.76	0.77	0.67	0.49	
14. Load Use Factor	1.00	0.99	0.97	0.94	0.89	0.87	0.96	0.88	0.74	0.73	0.96	1.00	
15. Power Main Demand KW	186.05	145.24	125.30	102.72	101.48	89.79	78.53	88.07	127.91	126.37	149.95	170.68	1,492
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	189.05	152.84	137.30	118.72	101.48	89.79	78.53	88.07	127.91	126.37	149.95	170.68	1,531
19. Hydro Enrgery Prod. MWH	61.83	55.84	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.38	61.83	935
20. Total Energy Req'd MWH	140.66	102.71	102.15	85.48	75.50	64.65	58.43	65.53	92.09	94.02	107.77	126.98	1,116
21. Diesel Energy Req'd MWH	78.83	46.86	40.33	25.65	0	0	0	0	17.21	16.64	33.09	65.16	324

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2002	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	337.12	292.40	240.80	223.60	237.36	213.28	178.88	233.92	278.64	261.44	326.80	344.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MWH	1167	1167	1167	1167	1167	1167	1167	1167	1167	1167	1167	1167	
10. Net Produc. MWH	141.21	100.36	98.03	80.52	86.36	75.86	61.85	75.86	100.36	102.70	114.37	129.54	
11. Avg. Load KW	189.79	149.35	131.76	111.84	116.07	105.35	83.13	101.96	139.39	138.03	158.84	174.11	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.44	0.56	0.63	0.74	0.90	0.99	1.25	1.02	0.75	0.75	0.65	0.48	
14. Load Use Factor	1.00	1.00	0.97	0.94	0.90	0.87	0.95	0.87	0.94	0.94	0.97	1.00	
15. Power Main Demand KW	189.79	148.64	128.30	105.27	104.13	91.73	79.38	89.11	131.09	129.51	153.57	174.11	1,525
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	192.79	156.24	140.30	121.27	104.13	91.73	79.38	89.11	131.09	129.51	153.57	174.11	1,563
19. Hydro Engery Prod. MWH	61.93	55.84	61.83	59.83	77.38	74.98	77.38	77.38	74.38	77.38	74.89	61.83	335
20. Total Energy Req'd MWH	143.44	104.99	104.39	87.32	77.47	66.05	59.06	66.30	94.38	96.36	110.57	129.54	1,140
21. Diesel Energy Req'd MWH	81.61	49.15	42.56	27.48	0.09	0	0	0	19.50	19.98	25.69	67.71	345

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2003	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	343.00	297.50	245.00	227.50	241.50	217.00	182.00	238.00	283.50	266.00	332.50	350.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MWH	1190	1190	1190	1190	1190	1190	1190	1190	1190	1190	1190	1190	
10. Net Produc. MWH	143.99	102.34	99.96	82.11	88.06	77.35	63.07	77.35	102.34	104.72	116.62	132.09	
11. Avg. Load KW	193.53	152.29	134.35	114.04	118.36	107.43	84.77	103.97	142.14	140.75	161.97	177.54	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.43	0.55	0.62	0.73	0.88	0.97	1.23	1.00	0.73	0.74	0.64	0.47	
14. Load Use Factor	1.00	1.00	0.98	0.95	0.90	0.88	0.95	0.87	0.94	0.94	0.97	1.00	
15. Power Main Demand KW	193.53	152.04	131.30	107.82	106.77	94.13	80.23	90.15	134.26	132.66	157.19	177.54	1,559
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	93.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	196.53	159.64	143.30	123.82	106.77	94.13	80.23	90.15	134.26	132.66	157.19	177.54	1,596
19. Hydro Enrgy Prod. MWH	61.83	55.84	61.83	59.83	77.38	74.98	77.38	77.38	74.88	77.38	74.88	61.83	835
20. Total Energy Req'd MWH	146.22	107.28	106.62	89.15	79.44	67.78	59.69	67.07	96.67	98.70	113.13	132.09	1,164
21. Diesel Energy Req'd MWH	84.40	51.44	44.79	29.32	2.06	0	0	0	21.79	21.32	38.30	70.26	364

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2004	31	29	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	349.86	303.45	249.90	232.05	246.33	221.34	185.64	242.76	289.17	271.32	339.15	357.06	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1214	1214	1214	1214	1214	1214	1214	1214	1214	1214	1214	1214	
10. Net Produc. MMH	146.89	104.40	101.98	83.77	89.84	78.91	64.34	78.91	104.40	106.83	118.97	134.75	
11. Avg. Load KW	197.44	150.01	137.06	116.34	120.75	109.60	86.48	106.06	145.01	143.59	165.24	181.12	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.42	0.55	0.61	0.71	0.86	0.95	1.20	0.98	0.72	0.72	0.63	0.46	
14. Load Use Factor	1.00	1.00	0.98	0.95	0.91	0.88	0.94	0.87	0.95	0.95	0.97	1.00	
15. Power Main Demand KW	197.44	149.40	134.44	110.48	109.53	96.64	81.11	92.55	137.58	135.94	160.97	181.12	1,587
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	200.44	157.00	146.44	126.48	109.53	96.64	81.11	92.55	137.58	135.94	160.97	181.12	1,626
19. Hydro Energy Prod. MMH	61.83	57.34	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.38	61.83	837
20. Total Energy Req'd MMH	149.13	109.27	108.95	91.07	31.49	69.58	60.35	68.36	99.05	101.14	115.90	124.75	1,190
21. Diesel Energy Req'd MMH	87.30	51.43	47.12	31.23	4.11	0	0	0	24.17	23.76	41.02	72.93	380

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2005	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	356.72	309.40	254.80	236.60	251.16	225.68	189.28	247.52	294.84	276.64	345.80	364.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MWH	1238	1238	1238	1238	1238	1238	1238	1238	1238	1238	1238	1238	
10. Net Produc. MWH	149.80	106.47	103.99	85.42	91.61	80.47	65.61	80.47	106.47	108.94	121.32	137.42	
11. Avg. Load KW	201.34	158.43	139.77	118.64	123.13	111.76	88.19	108.16	147.97	146.43	168.51	184.70	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.41	0.52	0.59	0.70	0.84	0.93	1.18	0.96	0.70	0.71	0.62	0.45	
14. Load Use Factor	1.00	1.00	0.98	0.95	0.91	0.89	0.93	0.88	0.95	0.95	0.98	1.00	
15. Power Main Demand KW	201.34	158.43	137.57	113.14	112.29	99.14	81.99	94.98	140.89	139.22	164.74	184.70	1,628
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	93.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	204.34	166.03	149.57	129.14	112.29	99.14	81.99	94.98	140.89	139.22	164.74	184.70	1,667
19. Hydro Engery Prod. MWH	61.83	55.84	61.83	59.93	77.38	74.88	77.38	77.38	74.88	77.38	74.88	61.83	935
20. Total Energy Req'd MWH	152.93	111.58	111.28	92.98	93.54	71.38	61.00	70.66	101.44	103.58	118.62	137.42	1,216
21. Diesel Energy Req'd MWH	90.20	55.73	49.45	33.15	6.17	0	0	0	26.56	26.21	43.74	75.59	407

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2006	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	363.58	315.35	259.70	241.15	255.99	230.02	192.92	252.28	300.51	281.96	352.45	371.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MWH	1262	1262	1262	1262	1262	1262	1262	1262	1262	1262	1262	1262	
10. Net Produc. MWH	152.70	108.53	106.01	87.08	93.39	82.03	66.89	82.03	108.53	111.06	123.68	140.08	
11. Avg. Load KW	205.24	161.51	142.48	120.94	125.52	113.93	89.90	110.26	150.74	149.27	171.77	188.28	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.40	0.51	0.58	0.69	0.83	0.91	1.16	0.94	0.69	0.70	0.61	0.44	
14. Load Use Factor	1.00	1.00	0.99	0.96	0.92	0.89	0.92	0.88	0.96	0.95	0.98	1.00	
15. Power Main Demand KW	205.24	161.51	140.70	115.80	115.05	101.65	82.88	97.40	144.20	142.50	168.52	198.28	1,664
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	298.24	169.11	152.70	131.90	115.05	101.65	82.88	97.40	144.20	142.50	168.52	198.28	1,792
19. Hydro Energy Prod. MWH	61.83	55.94	61.83	59.83	77.38	74.88	77.38	77.38	74.58	77.39	74.29	61.83	835
20. Total Energy Req'd MWH	154.93	113.64	113.61	94.89	85.60	73.19	61.66	72.47	103.33	106.92	121.34	140.08	1,241
21. Diesel Energy Req'd MWH	93.11	57.30	51.78	35.06	8.22	0	0	0	28.95	23.65	46.46	78.26	428

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2007	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	370.44	321.30	264.60	245.70	260.82	234.36	196.56	257.04	306.18	287.28	359.10	379.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MWh	1288	1288	1288	1288	1288	1288	1288	1288	1288	1288	1288	1288	
10. Net Produc. MWh	155.85	110.77	108.19	88.87	95.31	83.72	68.26	83.72	110.77	113.34	126.22	142.97	
11. Avg. Load KW	209.47	164.83	145.42	123.43	128.11	116.28	91.75	112.53	153.84	152.34	175.31	192.16	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.40	0.50	0.57	0.67	0.81	0.89	1.13	0.92	0.68	0.68	0.59	0.43	
14. Load Use Factor	1.00	1.00	0.99	0.96	0.92	0.90	0.91	0.89	0.96	0.96	0.98	1.00	
15. Power Main Demand KW	209.47	164.83	144.10	118.68	118.04	104.36	83.84	100.03	147.79	146.06	172.61	192.16	1,702
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	212.47	172.43	156.10	134.68	118.04	104.36	83.84	100.03	147.79	146.06	172.61	192.16	1,741
19. Hydro Energy Prod. MWh	61.83	55.84	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.88	61.83	335
20. Total Energy Req'd MWh	158.08	115.88	116.14	96.97	87.32	75.14	62.27	74.42	106.41	108.67	124.28	142.97	1,269
21. Diesel Energy Req'd MWh	96.25	60.03	54.31	37.14	10.45	0.26	0	0	31.53	31.29	49.40	81.14	452

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2008	31	29	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	378.28	328.10	270.20	250.90	266.34	239.32	200.72	262.48	312.66	293.36	366.70	386.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1314	1314	1314	1314	1314	1314	1314	1314	1314	1314	1314	1314	
10. Net Produc. MMH	158.99	113.00	110.38	90.67	97.24	85.41	69.64	85.41	113.00	115.63	128.77	145.85	
11. Avg. Load KW	213.70	162.36	148.35	125.93	130.69	118.63	93.60	114.80	156.95	155.42	178.85	196.04	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.39	0.51	0.56	0.66	0.80	0.88	1.11	0.91	0.66	0.67	0.58	0.42	
14. Load Use Factor	1.00	1.00	0.99	0.97	0.93	0.90	0.91	0.89	0.96	0.96	0.99	1.00	
15. Power Main Demand KW	213.70	162.36	147.49	121.56	121.03	107.08	84.79	102.65	151.39	149.62	176.70	196.04	1,734
16. Hydro Power Gen. KW	33.10	83.10	93.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	93.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	216.70	169.96	159.49	137.56	121.03	107.08	84.79	102.65	151.39	149.62	176.70	196.04	1,773
19. Hydro Energy Prod. MMH	61.33	57.84	61.83	59.83	77.38	74.88	77.38	77.39	74.38	77.38	74.38	61.33	657
20. Total Energy Req'd MMH	161.23	118.29	118.66	99.04	90.05	77.10	63.09	76.37	109.30	111.31	127.23	145.35	1,297
21. Diesel Energy Req'd MMH	99.40	60.46	56.83	39.21	12.67	2.22	0	0	34.12	33.94	52.35	94.03	475

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2009	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	385.14	334.85	275.10	255.45	271.17	243.66	204.36	267.24	318.33	298.68	373.35	393.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MWH	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	
10. Net Produc. MWH	162.14	115.24	112.56	92.46	99.16	87.10	71.02	87.10	115.24	117.92	131.32	148.74	
11. Avg. Load KW	217.93	171.49	151.29	128.42	133.28	120.97	95.46	117.07	160.06	158.49	182.39	199.92	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.38	0.48	0.55	0.65	0.78	0.86	1.09	0.89	0.65	0.66	0.57	0.42	
14. Load Use Factor	1.00	1.00	1.00	0.97	0.93	0.91	0.90	0.90	0.97	0.97	0.99	1.00	
15. Power Main Demand KW	217.93	171.49	150.88	124.44	124.02	109.79	85.75	105.28	154.98	153.17	180.80	199.92	1,778
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.68	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	220.93	179.09	162.88	140.44	124.02	109.79	85.75	105.28	154.98	153.17	180.80	199.92	1,817
19. Hydro Energy Prod. MWH	61.93	55.84	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.88	61.83	835
20. Total Energy Req'd MWH	164.37	120.35	121.19	101.12	92.27	79.85	63.80	78.33	111.58	113.96	130.17	148.74	1,325
21. Diesel Energy Req'd MWH	102.55	64.50	59.36	41.28	14.89	4.17	0	0.95	36.70	36.58	55.29	86.91	503

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2010	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	392.98	340.85	288.70	260.65	276.69	248.62	208.52	272.68	324.81	304.76	380.95	401.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1367	1367	1367	1367	1367	1367	1367	1367	1367	1367	1367	1367	1367
10. Net Produc. MMH	165.41	117.56	114.83	94.32	101.16	88.86	72.45	88.86	117.56	120.30	133.97	151.74	
11. Avg. Load KW	222.32	174.94	154.34	131.00	135.97	123.41	97.38	119.43	163.28	161.69	196.06	203.95	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.37	0.48	0.54	0.63	0.76	0.84	1.07	0.87	0.64	0.64	0.56	0.41	
14. Load Use Factor	1.00	1.00	1.00	0.97	0.93	0.91	0.89	0.90	0.97	0.97	0.99	1.00	
15. Power Main Demand KW	222.32	174.94	154.34	127.43	127.12	112.61	86.75	108.01	158.70	156.86	185.04	203.95	1,818
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	93.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	225.32	182.54	166.34	143.43	127.12	112.61	86.75	108.01	158.70	156.86	185.04	203.95	1,857
19. Hydro Energy Prod. MMH	61.83	55.84	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.88	61.83	835
20. Total Energy Req'd MMH	167.64	122.67	123.76	103.27	94.58	81.08	64.54	90.36	114.27	116.71	133.23	151.74	1,354
21. Diesel Energy Req'd MMH	105.81	66.83	61.93	43.44	17.20	6.20	0	2.98	39.39	39.33	58.35	89.91	531

RIGOLET MINI-HYDRO - P & E STUDY (For 125 MW Unit)
(Based on 1982 Forecast Data)

Year 2011	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Soil m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load MW	400.82	347.65	286.30	265.85	282.21	253.58	212.68	278.12	331.29	310.84	388.53	409.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1395	1395	1395	1395	1395	1395	1395	1395	1395	1395	1395	1395	
10. Net Produc. MMH	168.88	119.97	117.18	96.26	103.23	90.68	73.94	90.68	119.97	122.76	136.71	154.85	
11. Avg. Load MW	226.88	178.53	157.50	133.69	138.75	125.94	99.38	121.88	166.63	165.00	189.88	208.13	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.37	0.47	0.53	0.62	0.75	0.83	1.05	0.85	0.62	0.63	0.55	0.40	
14. Load Use Factor	1.00	1.00	1.00	0.98	0.94	0.92	0.88	0.91	0.98	0.97	1.00	1.00	
15. Power Main Demand MW	226.88	178.53	157.50	138.53	130.34	115.53	87.78	110.83	162.57	160.69	189.45	208.13	1,859
16. Hydro Power Gen. MW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand MW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	229.88	186.13	169.50	146.53	130.34	115.53	87.78	110.83	162.57	160.69	189.45	208.13	1,897
19. Hydro Energy Prod. MMH	61.83	55.84	61.83	59.83	77.38	74.89	77.38	77.38	74.89	77.38	74.89	61.83	835
20. Total Energy Req'd MMH	171.03	125.08	126.11	105.59	96.98	83.19	65.31	92.46	117.05	119.55	136.40	154.95	1,383
21. Diesel Energy Req'd MMH	109.20	69.23	64.28	45.67	19.60	6.30	0	5.08	42.17	42.18	61.52	93.02	560

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2012	31	29	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	408.66	354.45	291.90	271.05	287.73	298.54	216.84	283.56	337.77	316.92	396.15	417.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1423	1423	1423	1423	1423	1423	1423	1423	1423	1423	1423	1423	
10. Net Produc. MMH	172.18	122.38	119.53	98.19	105.30	92.50	75.42	92.50	122.38	125.22	139.45	157.95	
11. Avg. Load KW	231.43	175.83	160.66	136.37	141.53	128.47	101.37	124.32	169.97	168.31	193.69	212.30	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.36	0.47	0.52	0.61	0.73	0.81	1.03	0.94	0.61	0.62	0.54	0.39	
14. Load Use Factor	1.00	1.00	1.00	0.98	0.94	0.92	0.88	0.91	0.98	0.98	1.00	1.00	
15. Power Main Demand KW	231.43	175.83	160.66	133.64	133.56	118.45	88.81	113.66	166.44	164.52	193.69	212.30	1,993
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	234.43	183.43	172.66	149.64	133.56	118.45	88.81	113.66	166.44	164.52	193.69	212.30	1,932
19. Hydro Energy Prod. MMH	61.83	57.84	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.88	61.83	337
20. Total Energy Req'd MMH	174.42	127.67	128.46	107.74	99.37	95.29	66.07	34.56	119.83	122.40	139.45	157.95	1,412
21. Diesel Energy Req'd MMH	112.59	69.83	66.63	47.91	22.00	10.41	0	7.19	44.95	45.03	64.57	96.13	587

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2013	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	416.50	361.25	297.50	276.25	293.25	263.50	221.00	289.00	344.25	323.00	403.75	425.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1451	1451	1451	1451	1451	1451	1451	1451	1451	1451	1451	1451	
10. Net Produc. MMH	175.57	124.79	121.88	100.12	107.37	94.32	76.90	94.32	124.79	127.69	142.20	161.06	
11. Avg. Load KW	235.98	185.69	163.82	139.05	144.32	130.99	103.36	126.77	173.31	171.62	197.50	216.48	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.35	0.45	0.51	0.60	0.72	0.79	1.01	0.82	0.60	0.61	0.53	0.38	
14. Load Use Factor	1.00	1.00	1.00	0.98	0.95	0.93	0.87	0.92	0.98	0.98	1.00	1.00	
15. Power Main Demand KW	235.98	185.69	163.82	136.74	136.78	121.38	89.84	116.49	170.30	168.35	197.50	216.48	1,939
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	33.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	238.98	193.29	175.82	152.74	136.78	121.38	89.84	116.49	170.30	168.35	197.50	216.48	1,978
19. Hydro Energy Prod. MMH	61.83	55.84	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.38	61.83	535
20. Total Energy Req'd MMH	177.98	129.89	138.81	109.97	101.77	87.39	66.84	86.67	122.62	125.25	142.20	161.56	1,442
21. Diesel Energy Req'd MMH	115.98	74.05	68.99	50.14	24.39	12.51	0	9.29	47.74	47.88	67.32	99.23	618

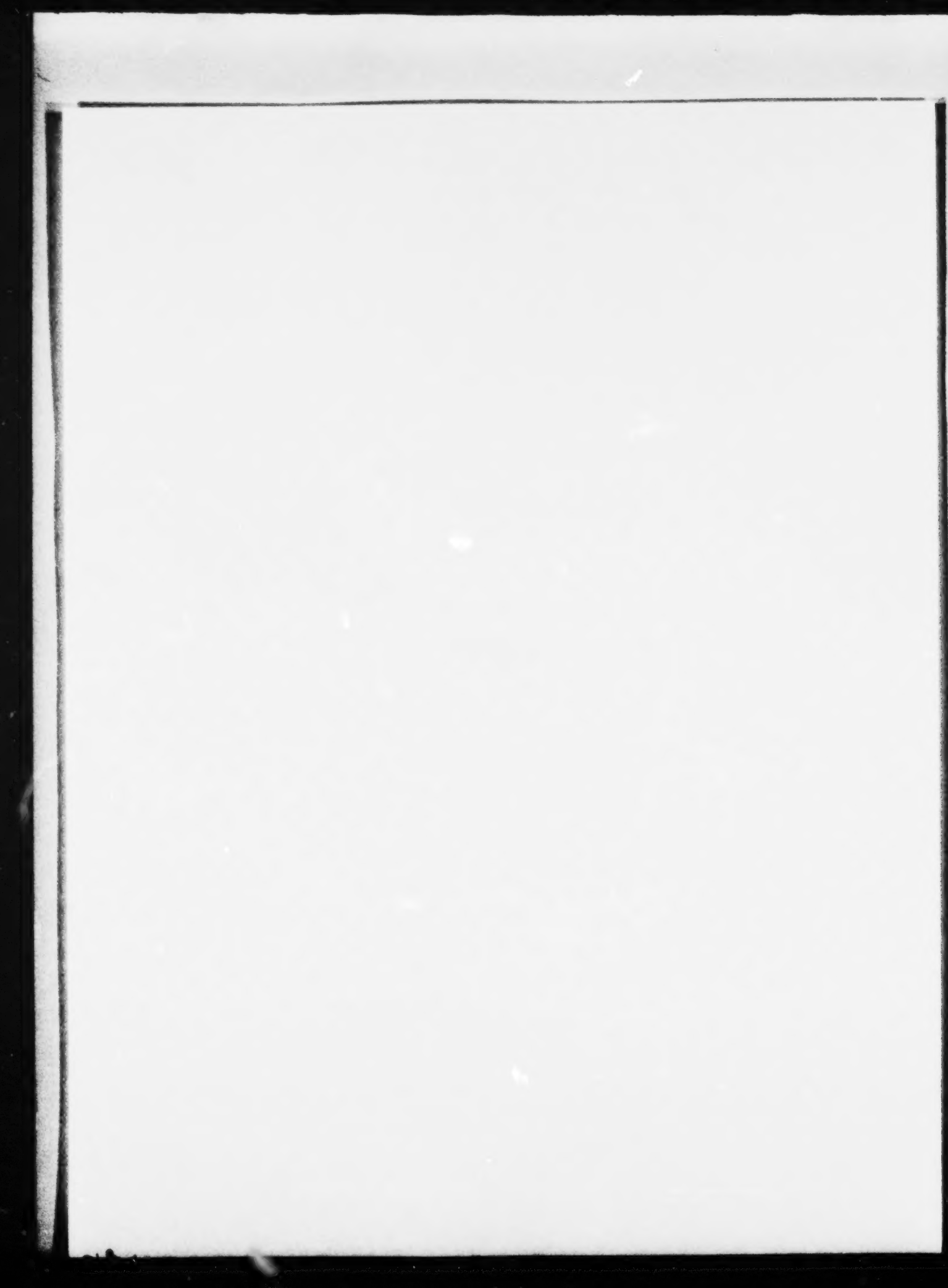
RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

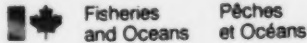
Year 2014	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.09	
6. Peak Load KW	424.34	368.05	303.10	281.45	298.77	268.46	225.16	294.44	358.73	329.08	411.35	433.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1480	1480	1480	1480	1480	1480	1480	1480	1480	1480	1480	1480	
10. Net Produc. MMH	179.08	127.28	124.32	102.12	109.52	96.20	78.44	96.20	127.28	130.24	145.04	164.28	
11. Avg. Load KW	240.70	189.40	167.10	141.83	147.20	133.61	105.43	129.30	176.78	175.05	201.44	220.81	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.35	0.44	0.50	0.59	0.71	0.78	0.99	0.90	0.59	0.59	0.52	0.38	
14. Load Use Factor	1.00	1.00	1.00	0.99	0.95	0.93	0.87	0.92	0.99	0.98	1.00	1.00	
15. Power Main Demand KW	240.70	189.40	167.10	139.95	140.12	124.40	91.82	119.42	174.31	172.32	201.44	220.81	1.982
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1.144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	243.70	197.00	179.10	155.95	140.12	124.40	91.82	119.42	174.31	172.32	201.44	220.81	2.020
19. Hydro Energy Prod. MMH	61.83	55.94	61.83	59.83	77.38	74.88	77.38	77.38	74.88	77.38	74.38	61.83	835
20. Total Energy Req'd MMH	181.31	132.39	133.25	112.28	104.25	89.57	68.32	98.85	125.50	129.20	145.04	164.28	1.475
21. Diesel Energy Req'd MMH	119.49	76.54	71.42	52.45	26.87	14.69	0	11.47	50.62	58.83	70.16	102.45	647

RIGOLET MINI-HYDRO - P & E STUDY (For 125 KW Unit)
(Based on 1982 Forecast Data)

Year 2015	31	28	31	30	31	30	31	31	30	31	30	31	
PARTICULARS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Accumul.
1. Basin Flow m3/s	0.12	0.10	0.08	0.14	1.39	2.07	0.70	0.55	0.48	0.58	0.37	0.19	
2. Modified B.Flow m3/s	0.31	0.31	0.31	0.31	0	0	0	0	0	0	0.40	0.31	
3. Plant Flow m3/s	0.31	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.31	
4. Plant Spill m3/s	0	0	0	0	0.99	1.67	0.30	0.15	0.08	0.18	0	0	
5. Peak Load Coeff.	0.98	0.85	0.70	0.65	0.69	0.62	0.52	0.68	0.81	0.76	0.95	1.00	
6. Peak Load KW	433.16	375.70	309.40	287.30	304.98	274.04	229.84	300.56	358.02	335.92	419.90	442.00	
7. Load Factor													
8. Production Coeff.	0.121	0.086	0.084	0.069	0.074	0.065	0.053	0.065	0.086	0.088	0.098	0.111	
9. Production Forecast MMH	1510	1510	1510	1510	1510	1510	1510	1510	1510	1510	1510	1510	
10. Net Produc. MMH	102.71	129.86	126.84	104.19	111.74	98.15	80.03	98.15	129.86	132.88	147.98	167.61	
11. Avg. Load KW	245.58	193.24	170.48	144.71	150.19	136.32	107.57	131.92	180.36	178.60	205.53	225.28	
12. Flow Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
13. R.P.P.	0.34	0.43	0.49	0.57	0.69	0.76	0.97	0.79	0.58	0.58	0.51	0.37	
14. Load Use Factor	1.00	1.00	1.00	0.99	0.96	0.94	0.88	0.93	0.99	0.99	1.00	1.00	
15. Power Main Demand KW	245.58	193.24	170.48	143.27	143.57	127.53	94.29	122.45	178.45	176.42	205.53	225.28	2,026
16. Hydro Power Gen. KW	83.10	83.10	83.10	83.10	104.00	104.00	104.00	104.00	104.00	104.00	104.00	83.10	1,144
17. Power Aux. Demand KW	3.00	7.60	12.00	16.00	0	0	0	0	0	0	0	0	39
18. Total Power Demand	248.58	200.84	182.48	159.27	143.57	127.53	94.29	122.45	178.45	176.42	205.53	225.28	2,065
19. Hydro Energy Prod. MMH	61.33	55.84	61.83	59.83	77.39	74.89	77.38	77.38	74.88	77.38	74.88	61.33	935
20. Total Energy Req'd MMH	184.94	134.97	135.77	114.68	106.81	91.82	70.15	91.10	128.49	131.25	147.98	167.61	1,506
21. Diesel Energy Req'd MMH	123.12	79.12	73.94	54.85	29.44	16.94	0	13.73	53.61	53.88	73.10	105.78	675

APPENDIX "D"
ENVIRONMENTAL IMPACT





Fisheries Research Branch
P.O. Box 5667
St. John's Newfoundland
A1C 5X1

5903-1-4

October 22, 1984

Mr. Charles Sheppard
Sheppard, Hedges and Green Ltd.
P.O. Box 1086
Clareville, Newfoundland
A0E 1J0

Dear Mr. Sheppard:

Re: Proposed Mini Hydro Project - Rigolet

In response to your letter of October 2, 1984 concerning the Rigolet Mini Hydro Study, the following comments are provided.

The Department of Fisheries and Oceans is unable, at this time, to evaluate potential environmental impacts to fish habitat resulting from this proposal due to a lack of both a resource data base and project details.

The local Fishery Officer, Mr. Derrick Pottle (Rigolet) has informed me that Rigolet Brook does support an anadromous salmonid population. There are no obstructions to fish migration up to Rigolet Pond. Where the fish in this watershed spawn, the type of habitat downstream from Rigolet Pond and the type of habitat at the inlets to the pond are unknown.

Your client would be responsible for providing the Department of Fisheries and Oceans with this information as well as the following project details.

- 1) How much water could be released on a monthly basis to sustain downstream fish habitat areas;
- 2) Whether a fishway could be incorporated into any proposed dam structure
- 3) Details on the design of the water intake structure, i.e depth, screen size, etc.

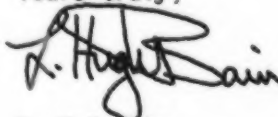
Canada

Mr. Charles Sheppard

October 22, 1984

Before the Department of Fisheries and Oceans is provided with this information we will not be in a position to let you know what mitigations the Department will expect of this project.

Yours truly,


for R. McCubbin

k1

cc: D. Pottle
B. Slade

Fisheries Research Branch
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1

5903-1-4

November 15, 1984

Mr. Charlie Sheppard, P. Eng.
Sheppard, Hedges and Green Ltd.
P.O. Box 1086
Clareville, Newfoundland
A0E 1J0

Dear Mr. Sheppard:

Re: Proposed Water Supply/Mini Hydro Project - Rigolet, Labrador

Pursuant to your letter of 29 October 1984 relating to the above-noted subject, the following comments are provided.

After reviewing the additional information you forwarded to me on the synthesized monthly flows for Rigolet Brook, there appears to be little or no room for mitigating the effects of this project on fish habitat. The data indicates that there is insufficient flow to sustain downstream fish habitat from November to April; therefore, this would preclude successful spawning in Rigolet Brook below Rigolet Pond. There also appears to be insufficient water to operate a fishway (with the exception of the month of June). In addition, there is probably not enough water available for spillage during the summer months to allow anadromous fish to successfully migrate up to Rigolet Pond during the migration season.

Considering, therefore, that all other options for a water supply source have been explored and have proven unfeasible, and that this watershed is not utilized by local residents for recreational angling to a large extent (per. comm. D. Pottle, DFO, Rigolet), the Department of Fisheries and Oceans is prepared to allow this watershed to be developed as per your original proposal.

As consultants for this project, I would ask that you inform the contractor for this project to apply to the DFO office in Goose Bay for an application for Authorization for Works or Undertakings Affecting Fish Habitat, at the following address:

Canada

Mr. Charlie Sheppard,

November 15, 1984

Habitat Protection Officer
Department of Fisheries and Oceans
P.O. Box 7003
Station A
Goose Bay, Labrador
AOP 1C0

Any site specific construction-related mitigations that DFO feels are necessary will be placed on the project at that time.

The only design aspect of this project that I will address is that of the water intake structure. It is necessary to screen water intake structures so as to prevent the entry of fish and subsequent fish kills.

The screen for the intake in Rigolet Pond should therefore be designed according to the following guidelines originally drafted by a watercourse alteration advisory committee in New Brunswick with input from the Department of Fisheries and Oceans:

1. Acceptable screening shall consist of two screens at least 5.0 cm apart.
2. The outer screen shall have not less than three meshes per 2.5 cm.
3. The inner screen shall have not less than eight meshes per 2.5 cm.
4. The openings in the inner screen shall be not more than 0.25 cm square.
5. The open areas of the two screens shall be approximately equal.
6. An area of 3.0 square metres of screen shall be provided for each 0.764 cubic metres per second of water diverted.
7. Screen panels or frames shall be suitably mounted with openings around the panels not larger than .25 cm.
8. The screen shall be cleared of debris at regular intervals.

Screens with the above specifications are applicable to relatively small diversions including pump intakes and are most suitable with a submerged intake.

Mr. Charlie Sheppard,

November 15, 1984

Should you have any questions relating to this project, do not hesitate to contact me at your convenience.

Yours truly,



R. McCubbin
Habitat Research and Assessment Section
Experimental Ecology Program

k1

cc: B. Slade
D. Pottle



GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF CULTURE, RECREATION AND YOUTH
HISTORIC RESOURCES DIVISION
Newfoundland Museum
285 Duckworth St.
St. John's, NF
A1C 1G9

Our file 406-3

26 November 1984

Mr. Charlie Sheppard
Sheppard, Hedges & Green Ltd.
P.O. Box 1086
Clareville, NF
A0E 1J0

Dear Mr. Sheppard:

RE: Proposed flooding at Rigolet

Thank you for your inquiry about archaeological sites near Rigolet. You mentioned that you plan to flood a small pond north of the town. I therefore assume that this is not the larger of the two ponds in the area, as the larger one is west of the town according to the NTS map 13J/1. In any case, the choice of either pond would probably not endanger any of the three sites on record for the immediate area of the town. One is located at Double Mer Point and the other two are east of Rigolet, across the Narrows.

Hamilton Inlet is an extremely rich area archaeologically and we do appreciate your consideration of site damage.

Thank you, I am

Yours truly,

A handwritten signature in cursive script, reading "Jane Sproull Thomson".

JANE SPROULL THOMSON
Curator of Archaeology/Ethnology

JST/kaw



APPENDIX "E"
ECONOMIC EVALUATION

RIGOLET MINI HYDRO STUDY
DIESEL PLANT COST PROJECTIONS

Year	Diesel kWh M1000	Cap. Exp. M1000	Fuel (Lit) M1000	Fuel Cost M1000	Fuel & Lube M1000	Fixed M1000	Variable M1000	Total Cost M1000	P.M. Cost M1000	Com. P.M. Cost M1000
1983	744	---	275.8	107.6	113.1	101.9	10.4	225.4	---	---
1984	777	---	288.1	118.3	124.3	106.4	10.9	241.5	---	---
1985	797	---	295.5	127.6	134.2	111.0	11.7	256.9	227.4	227.4
1986	817	---	302.9	137.7	144.7	115.9	12.5	273.2	213.9	441.3
1987	838	---	310.7	148.6	156.2	121.0	13.4	290.6	201.4	642.7
1988	859	---	318.5	160.3	168.5	126.3	14.4	309.1	189.6	832.3
1989	870	---	322.5	170.8	179.6	131.8	15.2	326.6	177.2	1009.5
1990	901	---	334.0	185.2	195.7	137.6	16.4	349.7	168.0	1177.5
1991	924	---	342.6	200.9	211.2	143.6	17.6	372.4	158.3	1335.8
1992	947	---	351.1	216.7	227.8	149.9	18.8	396.5	149.1	1484.9
1993	971	---	360.0	233.8	245.8	155.4	20.1	422.3	140.6	1625.5
1994	996	---	369.3	252.4	265.3	163.3	21.5	450.1	132.6	1758.1
1995	1016	---	376.7	270.9	284.8	170.4	22.9	478.2	124.7	1882.6
1996	1035	---	383.7	290.4	305.3	177.9	24.4	507.6	117.1	1999.9
1997	1057	---	391.9	312.1	328.1	185.7	26.0	539.8	110.2	2110.1
1998	1077	---	399.3	334.6	351.8	193.8	27.7	573.2	103.6	2213.7
1999	1099	---	407.4	359.3	377.7	202.3	29.5	609.5	97.5	2311.1
2000	1122	---	416.0	386.0	405.8	211.2	31.4	648.4	91.7	2402.9
2001	1144	---	424.1	414.2	435.4	220.4	33.4	689.2	86.3	2489.2
2002	1167	---	432.7	444.6	467.4	230.1	35.6	733.0	81.2	2570.4
2003	1190	---	441.2	477.1	501.5	240.2	37.9	779.5	76.4	2646.8
2004	1214	---	450.1	512.1	538.4	250.7	40.3	829.4	72.0	2718.8
2005	1238	---	459.0	546.4	574.4	261.7	42.9	879.0	67.5	2786.3
2006	1262	---	467.9	582.7	612.6	273.7	47.8	934.1	63.5	2849.8
2007	1288	---	477.5	622.2	654.1	286.2	51.1	991.4	59.6	2909.4
2008	1314	---	487.2	664.1	698.1	299.4	54.5	1052.0	56.0	2965.4
2009	1340	---	496.8	708.5	744.8	313.1	58.1	1116.0	52.6	3018.0
2010	1367	---	506.8	756.2	794.9	327.5	62.0	1184.4	49.4	3067.3
2011	1395	---	517.2	807.3	848.7	342.5	66.2	1257.4	46.4	3113.7
2012	1423	---	527.6	861.6	905.7	358.2	70.6	1334.5	43.6	3157.3
2013	1451	---	537.9	919.1	966.2	374.7	75.3	1416.2	40.9	3198.2
2014	1480	---	548.7	980.8	1031.0	391.9	80.3	1503.2	38.4	3236.6
2015	1510	---	559.8	1046.9	1100.5	409.9	85.7	1596.1	36.1	3272.7

RIGOLET MINI HYDRO STUDY

HYDRO/DIESEL COST PROJECTIONS

Year	Forecast				Diesel				Hydro				Cumulative P.M. Cost M 1000
	Load (KW)	Hydro MHT	Diesel MHT	Cap Exp M 1000	Fuel Cost M 1000	Fuel & Lube M 1000	Fixed M 1000	Variable M 1000	Fixed M 1000	Yot Cost M 1000	P.M. Cost M 1000		
1983	744		744		275.8		101.9	10.4	0.0				
1984	777		777		288.1		106.4	11.0	0.0			256.9	227.3
1985	797	0.0	797	0	295.3	134.2	111.0	11.7	0.0			267.2	245.5
1986	817	197.0	620	2630	229.9	109.8	115.9	9.9	2.0			160.4	111.2
1987	838	688.0	150	0	55.6	28.0	121.0	2.4	9.1			170.7	104.7
1988	859	695.0	164	0	60.8	30.6	126.3	2.7	9.5			179.5	97.4
1989	870	701.0	163	0	62.7	32.9	131.8	3.0	9.9			193.4	92.9
1990	901	708.0	193	0	71.6	39.9	137.6	3.5	10.3			203.6	87.4
1991	924	717.0	207	0	76.7	45.0	143.6	3.9	10.8			219.0	82.4
1992	947	725.0	222	0	82.3	50.8	149.9	4.4	11.3			233.1	77.6
1993	971	734.0	237	0	87.9	57.1	156.4	4.9	11.8			249.6	73.5
1994	996	739.0	257	0	95.3	65.1	163.3	5.6	12.3			265.3	69.4
1995	1016	742.0	274	0	101.6	73.1	170.4	6.2	12.8			283.7	65.4
1996	1035	745.0	290	0	107.5	81.4	177.9	6.8	13.4			302.8	61.8
1997	1057	749.0	308	0	113.2	90.9	185.7	7.6	14.0			322.9	58.3
1998	1077	752.0	325	0	120.5	101.0	193.8	8.3	14.6			344.6	55.1
1999	1099	756.0	343	0	127.2	112.1	202.3	9.2	15.2			367.7	52.0
2000	1122	761.0	361	0	133.8	124.2	211.2	10.1	15.9			392.3	49.1
2001	1144	765.0	379	0	140.5	137.2	220.4	11.1	16.6			418.9	46.4
2002	1167	769.0	398	0	147.6	151.6	230.1	12.1	17.3			447.7	43.9
2003	1190	772.0	418	0	155.0	167.6	240.2	13.3	18.1			469.0	40.7
2004	1214	777.0	437	0	162.0	184.4	250.7	15.6	18.9			509.2	39.1
2005	1238	781.0	457	0	169.4	201.7	261.7	15.8	19.7			543.1	36.9
2006	1262	785.0	477	0	176.8	220.3	273.7	17.3	20.5			579.5	33.9
2007	1288	790.0	498	0	184.6	240.6	286.2	18.9	21.4			619.8	33.0
2008	1314	792.0	522	0	193.5	263.8	299.4	20.7	22.4			709.9	29.6
2009	1340	794.0	546	0	202.4	288.7	313.1	22.6	23.4			760.2	28.0
2010	1367	794.0	573	0	212.4	317.0	327.5	24.9	24.4			813.7	26.6
2011	1395	795.0	600	0	222.4	347.2	342.5	27.2	25.3			870.4	25.1
2012	1423	796.0	627	0	232.5	379.5	358.2	29.8	26.6			931.4	23.8
2013	1451	797.0	654	0	242.8	414.3	371.9	32.5	27.7			996.1	22.5
2014	1480	798.0	682	0	252.8	452.0	391.9	35.4	29.0				
2015	1510	800.0	710	0	263.2	492.3	409.9	38.6	30.2				

PERSONAL COMMUNICATIONS:

Gower, C.F.	Project Geologist, Environmental Geology Section, Department of Mines and Energy, Government of Newfoundland and Labrador;
Luttich, S.	Regional Wildlife Biologist, Labrador Wildlife Division, Department of Culture, Recreation and Youth, Government of Newfoundland and Labrador;
McCubbin, R.	Technician, Habitat Research and Assessment Section, Fisheries and Oceans, Canada.
Sprouell-Thompson, J.	Curator of Archaeology/Ethnology, Historic Resources Division, Department of Culture, Recreation and Youth, Government of Newfoundland and Labrador;
Dominie, K.	Civil Sanitary Engineer, Department of Environment, Government of Newfoundland and Labrador;
Banfield, C.E.	Department of Geography, Memorial University of Newfoundland.

REFERENCES:

- | | |
|--------------------|---|
| Shawmont Nfld Ltd. | - Study of Small Scale Hydro for Newfoundland and Labrador; |
| Nfld & Lab Hydro | - Mary's Harbour Mini Hydro Development; |
| | - Roddickton Mini Hydro Development |
| Golder Assoc. Ltd. | - Rigolet Airport Soils Investigation |